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Development of Candidate Crew Coordination Evaluation Methods and Materials

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This report documents the development of candidate methods and materials for measuring and evaluating crew coordination in the Army's Aircrew Coordination Training Program. The methods are designed for use in evaluating aircrews in all Army aircraft or simulators. The evaluation methods rely on video recording of crew interactions in a simulator or aircraft. The report includes lessons learned from the validation testbed and describes how the evaluation methods and materials were improved to produce a freed exportable evaluation package. The suggested process for evaluating crew coordination is designed to assist the Army to implement the new Aircrew Training Manuals. The primary evaluation measure is the ACE Checklist, which consists of a set of 13 crew coordination behaviors or Basic Qualities. Mission performance measures were developed to assess the operational effect of crew coordination on flight safety and mission effectiveness. The report provides materials and suggested applications and improvements that can be used to evaluate initial, refresher, and continuation aircrew coordination training conducted in resident courses or by units in the field. Evaluation materials include grade slips, behavioral measures, evaluator worksheets, and suggested mission performance measures, which are all packaged separately in a companion report, Crew Coordination Exportable Evaluation Package for Army Aviation.

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DEVELOPMENT OF CANDIDATE CREW COORDINATION EVALUATION METHODS AND MATERIALS

June 1993

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DEVELOPMENT OF CANDIDATE CREW COORDINATION EVALUATION METHODS AND MATERIALS

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DEVELOPMENT OF CANDIDATE CREW COORDINATION EVALUATION METHODS AND MATERIALS

Introduction

The development of crew coordination training and evaluation methods is driven primarily by the need to reduce Army aviation accidents and increase mission effectiveness. Aviation accidents represent a major cost to the Army, and a significant portion of these accidents can be attributed to crew error. The U.S. Army Safety Center and US Army Research Institute (USARI) review of FY 1984 through FY 1989 aircraft accidents revealed that crew error directly contributed to 147 fatalities and $292 million in aviation accident costs across the Army. A significant number of these accidents were caused by the failure of experienced and qualified crew members to effectively coordinate their decisions and actions in the cockpit. While aviation accidents represent a highly visible piece of the problem, degraded mission effectiveness can also be attributed to a similar pattern of crew errors. Research conducted by the US Army Research Institute (USARI) in 1990 with UH-60 aircrews suggested that significant improvements in mission effectiveness would result from better crew coordination. Thus, the focus of this training development research was to identify training and evaluation methods that would serve to reduce crew error and its consequences.

Crew coordination training programs have existed for years within the commercial aviation industry. Such programs have responded to similar needs within commercial aviation to reduce accident rates. While much of the training was similar to that needed by the Army, the evaluation of crew performance lacked meaningful standards. As a result, training effectiveness could be measured only in terms of attitudinal changes, rather than behavioral or performance changes. This lack of meaningful evaluation standards was identified by the Army as a major weakness of previous training programs.

At the same time, it was recognized that the demands of tactical aviation were not exactly matched with those of commercial aviation. For example, responding to an emergency at an altitude of 50 feet under night vision goggle conditions requires a different approach from that taken in responding to an emergency at 35,000 feet. The failure of previous training programs to discuss crew coordination issues within the specific context of Army aviation tasks, conditions, and standards represented a second weakness of these existing programs.

Hence, it was concluded that a new approach to crew coordination training should be developed. This approach would build upon the successful elements of previous training programs available from commercial aviation and the other military services. At the same time, the new training program had to both (1) incorporate meaningful evaluation standards and (2) relate crew coordination ideas to the specific tasks, conditions, and

standards associated with Army flight operations. Finally, the focus of training and evaluation had to extend beyond the classroom in order to be relevant to Army aviators. The bottom line measure of success for this training program was a reduction in crew error-induced accidents and degraded mission effectiveness. Hence, training and evaluation has to take place in the cockpit where meaningful measures of behavior and performance can be obtained. It was this combined set of goals to which the present research and development effort responded.

Over the last several years, USARI's Aviation Research and Development Activity (ARDA) has been conducting a program of training research that responds to the Army's need for better crew coordination training. This program of research has been conducted in close cooperation with the US Army Aviation Center (USAAVNC) and its effort to revise its training standards to reflect increased emphasis on crew-level performance. The following report describes the most recent phase of this research, orchestrated by USARI ARDA and USAAVNC experts and technically supported by Dynamics Research Corporation.

Purpose

This report documents work performed by Dynamics Research Corporation (DRC) to develop candidate methods and materials for evaluating Army aircrew coordination skills in the rotary wing cockpit. It summarizes for ARIARDA and USAAVNC the past research and current guidelines used to develop an evaluation package for a crew coordination training validation testbed. The report describes how the evaluation methods and materials were developed for the exportable training package and the exportable evaluation package. By design, the evaluation methods documented in this report are general enough for use in evaluating aircrew coordination in all mission and type Army aircraft or simulators. The report provides ARIARDA and USAAVNC with materials and suggested applications and improvements that can be used to evaluate initial, refresher, and continuation aircrew coordination training conducted in resident courses or by units in the field.

Overview

The crew coordination training validation testbed was central to developing the candidate evaluation methods and materials (see Figure 1). Research findings from a 1990 testbed, jointly sponsored by the USAAVNC and the USARI were advanced within the USAAVNC's current guidelines on crew coordination to develop the evaluation package used in the testbed. Research materials used in the testbed evaluation package were reviewed based on lessons learned and USAAVNC guidelines that evaluation procedures must be readily useable by units in the field. Candidate evaluation materials from the Validation Testbed Evaluation Package were revised and incorporated into the Field Exportable Training Package which is designed to be used in

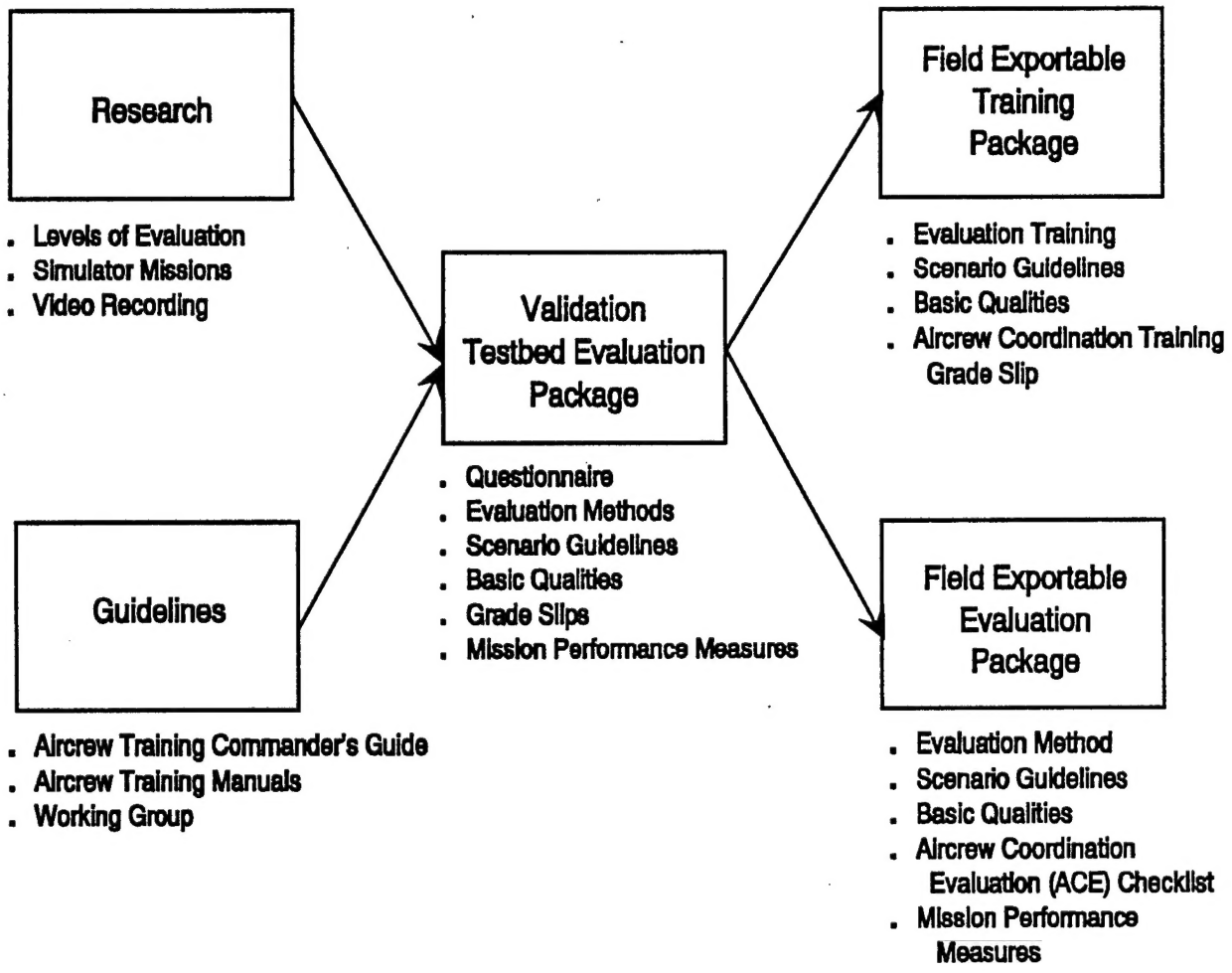

Figure 1. Research overview

initial and/or refresher training and the Field Exportable Evaluation Package which is to be used for continuation training implemented by USAAVNC.

Table 1 diagrams the development and relationship between the evaluation materials used in the 1990 and 1992 research testbeds and the field exportable evaluation materials described in this report. The table also indicates where the reader can find detailed information on each of the testbed and exportable evaluation materials. Information on the levels of evaluation is introduced in the next section.

Table 1

Relationship Between Testbed and Exportable Evaluation Materials

Level of Evaluation	1990 Testbed	1992 Testbed	Field Exportable Training Package	Field Exportable Evaluation Package
Attitude	Army Aviation Crewmember Questionnaire, 45 items	Army Aviation Crewmember Questionnaire, 46 items	N/A	N/A
Behavior	UH-60 Aircrew Coordination Evaluation (ACE) Checklist, 19 Dimensions	Aircrew Coordination Training Grade Slips, 13 Basic Qualities	Aircrew Coordination Training Grade Slip, 13 Basic Qualities	Aircrew Coordination Evaluation (ACE) Checklist; 13 Basic Qualities,
	Behaviorally Anchored Rating Scale (1 thru 7); Generic ATM Task 1071, Perform as a Crewmember; Selected ATM Tasks Revised to Include Crew Coordination Standards	Behaviorally Anchored Rating Scale (1 thru 7); All ATM Tasks Include Crew Coordination Standards	Behaviorally Anchored Rating Scale (1 thru 7); All ATM Tasks Include Crew Coordination Standards	Behaviorally Anchored Rating Scale (1 thru 7); Commander Designated Crew Tasks
	Expanded Grading System (A, B, C, U, N/A)	Expanded Grading System (S+, S, S-, U)	Expanded Grading System (S+, S, S-, U)	Standard Grading System (S, U, N/A) with Expanded Grading System as Worksheet Input
Performance	Mission Performance Measures • Navigation • Threat • Instrument Flight	Mission Performance Measures • Navigation • Threat • Emergencies • Unexpected Event • Instrument Flight • Mission Threatening Crew Error • Amount of mission accomplished • Overall Flight (DA Form 7121-R)	Overall Flight Performance (DA Form 7121-R)	Overall Flight Performance (DA Form 7121-R) Mission Performance Development and Collection Guidance • Navigation • Threat • Emergencies • Unexpected Event • Instrument Flight • Mission Threatening Crew Error
Location of Detailed Information in this Report	**Section 2, Summary of Past Research**	**Section 4, Development of the Validation Testbed Evaluation Package**	**Development of Candidate Crew Coordination Training Methods and Materials**	**Section 6, Description of the Field Exportable Evaluation Package**

Summary of Past Research

For several years ARI has engaged in research and development of a new training and evaluation program for Army crew coordination. This section provides a brief summary of ARIARDA's crew coordination research program and major findings from past research conducted by ARIARDA and DRC.

During the late 1970's, the commercial airlines began to apply voice and flight recorders and other technologies to examine the affect of human performance on aircraft accidents. Parallel research by industry and government agencies extending well into the 1980's suggested approaches and offered programs for teaching cockpit management tasks. The military services noted the airline industry's lessons learned and began using the commercially-based cockpit resource management training programs. The Army adapted an Aircrew Training Program entitled Dynamics of Aircrew Communication and Coordination for its Initial Entry Rotary Wing course of instruction and purchased an exportable course for units in the field.

While the commercial airline concepts (e.g., attention, decision making, stress, attitude, and risk management) were applicable to military flight operations in general, their application to Army aviation's demanding flight environment was not obvious. For example, an airline crew's management of an emergency at 35,000 feet is very different from an Army aircrew's response to an emergency situation 50 feet above the terrain operating with night vision goggles. In 1987 the Army's Vice Chief of Staff asked ARI to initiate research aimed at reducing Army accident rates through better personnel selection, training, and system design.

Subsequent analysis of Army aviation accidents,conducted jointly by USARI and the U.S. Army Safety Center (USASC), showed that crew coordination errors represented a major category of human error induced accidents in aviation operations and that the Army lacked a reliable, objective means of assessing crew coordination in terms of safety and crew performance. Given these findings and recognition of the disparity between commercial and Army aviation flight environments, ARIARDA initiated a long-range research program in two phases (FY 89-93 and FY 94-99) to:

1. diagnose specific human error factors prevalent in Army aviation and ground operation accidents, and

2. identify promising strategies for reducing such accident causation factors through improved soldier selection, training, leadership, and organization.

In June 1989, ARI tasked DRC to develop measures for evaluating crew coordination training effectiveness and then in February 1990 ARI tasked DRC to translate the candidate measures

into techniques and procedures for identifying and documenting crew coordination errors in accident investigations. Table 2 and the remainder of this section summarize the major findings and products resulting from previous research developed by ARI and technically supported by DRC on crew coordination.

In 1989, ARI developed a program of research to identify solutions for improving and evaluating the coordination and performance of rotary wing aircrews. Technically supported by DRC, a portion of this research involved experimental evaluation of aircrew performance in the UH-60 Flight Simulator to determine specific relationships between crew coordination behaviors and safe and effective mission performance.

Major findings of this research showed the worth of flight simulators to crew coordination training and evaluation. Flight simulators allow crews to execute realistic mission scenarios under a variety of conditions and degrees of difficulty, including high risk tasks, and provide for the hands-on component of crew coordination training. Similarly, video recording of the simulator missions supports both evaluation and training by allowing playback and review of crew performance.

Table 2

Summary of ARIARDA and DRC Research (1989-1990)

Research Effort	Major Findings and Products
Development of Measures of Crew Coordination, August 1990	• Framework for training and evaluating Army Crew Coordination • Flight simulator applications to training and evaluation • Video recording support to training and evaluation • Levels of evaluation (attitude, behavior, performance) • Evaluation measures (attitude questionnaire, behavioral dimensions and rating scale, task performance) • Evaluation training course • Outline of training course for aviators
Development of Rating Instruments and Procedures for Aviation Mishap Investigation, September 1990	• ATM crew coordination elements-task errors • Crew coordination objectives-system inadequacies • Proposed revisions to DA Pam 385-95 • Training program for accident investigators
Results of the Data Analysis Army Aircrew Coordination Measures Testbed, Conducted Spring 1990, April 1991	• Relationship between measures of crew coordination and crew performance • Methodology to collect mission performance measures

Levels of Evaluation

The research method developed to assess crew coordination during the simulator experiments consisted of three levels of evaluation. The first level was crewmember **attitude**. The linkage between attitude and cockpit performance had been postulated by Helmreich (Helmreich, 1984 and Helmreich et al., 1986) who developed the Cockpit Management Attitudes Questionnaire (CMAQ) for the National Aeronautics and Space Administration (NASA).

The second level of evaluation was based on observable crew **behavior**. Helmreich and Wilhelm (1987) had developed and tested an instrument called the Line/LOFT (Line Oriented Flight Training) Worksheet, which used 17 dimensions of behavior to solicit expert ratings of crew performance. Applications of the Line/LOFT Worksheet had shown it to be useful in crew coordination proficiency evaluations.

The third level of evaluation was **performance**. The Army's Aircrew Training Manual (ATM) tasks, evaluated in the Annual Proficiency and Readiness Test (APART) program, were individual rather than crew tasks. Revisions to include crew coordination in selected ATM tasks were made. Crew performance was also examined by reviewing video tapes of completed mission outcomes.

Evaluation Measures

The crew coordination measurement suite paralleled the three levels of evaluation. The first component, **Army Aviation Crewmember Questionnaire**, was based on the military version of the Cockpit Management Attitudes Questionnaire (CMAQ) (Helmreich, 1984, Helmreich and Wilhelm, 1987). Several aspects of the basic CMAQ were altered to align with the Army's doctrine, terminology, and proposed crew coordination objectives to produce a 45 item attitude measurement instrument. The attitude instrument was administered to crewmembers and instructor pilot evaluators.

The **Aircrew Coordination Evaluation (ACE) Checklist** was the second component of the measurement suite. The NASA/University of Texas military version of the Line/LOFT Worksheet (Helmreich and Wilhelm, 1987) was the basis for the ACE Checklist. The Line/LOFT was modified to align its behavioral dimensions with the Army's crew coordination behavioral objectives. Written descriptions were prepared for each crew coordination dimension and its associated rating scale anchors for poor, acceptable, and superior performance. The resulting ACE Checklist of 19 crew coordination dimensions was administered to UH-60 crews by specially trained military instructor pilots.

Revised **Aircrew Training Manual (ATM) tasks** was the third evaluation measure. Aircrew Training Manual, Utility Helicopter UH-60 (Training Circular 1-212, 1988) was reviewed to identify tasks with:

1. significant aircrew coordination behaviors underlying their successful accomplishment, or

2. frequent citations in aviation accidents which could have been influenced by inclusion of aircrew coordination behaviors.

Selected tasks were rewritten to include crew coordination behaviors in the task's description, conditions, and standards. Detailed standards included in ATM task 1071, Perform as a Crew Member, were referenced by other tasks with crew coordination behaviors. The ATM grade slip was modified to allow separate evaluation of the flight skill and aircrew coordination components of the revised ATM tasks.

The Development of Measures of Crew Coordination research effort included developing and trying out a course of instruction on crew coordination principles and evaluation techniques. The course was designed to provide instructor pilot evaluators with the information necessary to understand and implement the evaluation procedures.

During a U.S. Army Safety Center (USASC) and ARIARDA review of FY 1984 through FY 1989 aircraft accidents, it became apparent that the basic framework used to develop measures of crew coordination could potentially be used to develop an improved methodology for investigating crew coordination errors during aviation accident investigations. In February 1990, ARIARDA tasked DRC to translate candidate measures into techniques and procedures for potential use by USASC accident investigation teams to identify and document crew coordination errors and system inadequacies.

Aviation accident case histories were subjected to an in depth analysis to determine to what degree, if any, aircrew coordination errors were a factor. The analysis resulted in definitions for nine task error categories and four system inadequacies or underlying causes that permit a crew coordination task error to become an accident cause. These definitions and their relationships were incorporated into a proposed Aircrew Coordination Accident Investigator Handbook designed to be used by the Human Factors member of USASC accident investigation boards. The Handbook provided guidance, format, and definitions required to identify and document aircrew coordination task errors resulting in or relevant to aircraft accidents.

DRC personnel validated the Handbook and gained experience in applying the new crew coordination definitions by actually participating in USASC aircraft accident investigations. Insights from the accident investigation process and interviews with accident crewmembers indicated that the crew coordination definitions adequately addressed all crew actions, especially the interactions among crewmembers. This direct feedback from the field helped more precisely define the aircrew coordination

principles and provide specific examples of observable crew performance. The definitions provided a practical means to link primary and secondary aircrew coordination errors while separating individual errors from crew errors contributing to an accident. This use of the definitions aided the development of clearly written descriptions of crew behavior levels for rating crew performance. The importance of crew climate, workload distribution, situation awareness, and the role of nonrated crewmembers was punctuated by the accident investigation experience.

DRC's research aligned the accident-based task error and system inadequacy definitions with the research-based ACE dimensions and crew coordination objectives. Once these relationships between accidents, task errors, and system inadequacies were established, USAAVNC used these notions in the revised Training Circulars as crew coordination elements and crew coordination objectives.

The final report on the 1990 testbed provided the results of a data analysis that examined the functional relationships between aircrew coordination attitudes, behaviors, and performance. The analysis concluded that crew coordination attitudes, behavior and performance were all related to each other and to mission related performance variables. The report included a comparison of crew performance based on variables identified by reviewing video tapes of completed missions. These mission performance variables illustrated the feasibility of developing mission-related crew performance measures.

Findings of this research combined with research conducted in-house by the U.S. Army led to the identification of several areas in which aircrew training and evaluation needed to be improved:

1. cockpit communication procedures,

2. management of crew workload in the cockpit,

3. cross-monitoring of crewmembers,

4. team relationships and crew climate, and

5. mission planning and rehearsal.

These five areas are published in the Army's Aircrew Training Program (Aircrew Training Program Commander's Guide to Individual and Crew Training, Training Circular 1-210) and Aircrew Training Manuals as objectives for crew coordination.

Summary of Guidelines for Crew Coordination

In 1991, the USAAVNC established a special crew coordination Working Group to incorporate crew coordination considerations into the Army's Aircrew Training Program. The Working Group guided the inclusion of major research findings and products such as the crew coordination objectives and crew coordination elements into program-wide Training Circulars and aircraft specific Aircrew Training Manuals (ATM). They also revised all ATM tasks to include crew coordination considerations. The new Training Circulars provided broad guidance on what to do but did not address the implementing details such as how to train unit aircrews. It was recognized that the areas of how to train crews on the newly announced crew coordination principles and how to evaluate crew performance were too general to ensure that the crew coordination initiative would succeed nor would it be able to achieve any degree of standardization. USAAVNC subsequently requested USARI to develop and validate an exportable training package for instructing experienced aviators in the field on the new crew coordination principles and ATM standards. Simultaneously, USAAVNC began work to incorporate this same material into the various schoolhouse training courses for new aviators.

This section provides a summary of the USAAVNC's written and verbal guidelines that transitioned the research findings and products from ARIARDA/DRC's 1989-1991 program into the validation testbed evaluation package. The primary sources of guidelines were the new Training Circulars (i.e., Commander's Guide and aircraft specific Aircrew Training Manuals) and the Crew Coordination Working Group. The Working Group, composed of representatives from the USAAVNC's Directorate of Training and Doctrine, Directorate of Evaluation and Standardization, Aviation Training Brigade, Center Safety, and ARIARDA, met with DRC's crew coordination project staff regularly to:

1. provide Training Circular updates,
2. clarify written guidelines,
3. review project progress,
4. participate in resolving issues, and
5. issue detailed guidelines.

Aircrew Training Program Commander's Guide

The newly published Aircrew Training Program Commander's Guide to Individual and Crew Training, Training Circular 1-210, describes Army Aviation's crew coordination training and evaluation philosophy and defines crew coordination:

Army Aviation's position on crew coordination is that "Planning, preflight, and in-flight tasks involve the cooperative effort of all crewmembers. The prescribed tasks, conditions, standards, and descriptions explain each crewmember's responsibility for the successful completion of maneuvers. Each crewmember must understand the actions and directives of the other crewmembers. This enhances crew coordination and unit interoperability and helps to prevent accidents caused by crew error" (p. iv).

The Training Circular specifies that "Aircrew training manuals (ATMs) published after this manual will incorporate the concept of crew coordination and training as a crew rather than training exclusively as an individual" (p. iv).

Crew coordination is defined as "a set of principles, attitudes, procedures, and techniques which transforms individuals into an effective crew" (p. 1-4).

The Commander's Guide also documents the five program-wide objectives for crew coordination and eight crew coordination elements identified in past research. The crew coordination objectives and elements are repeated in each ATM as guidance to implement crew coordination training and evaluation. These guidelines plus other information in the Commander's Guide on selecting crew tasks for evaluation, managing crew risk, and tracking crew performance provided the basis for developing the validation testbed evaluation package.

Revised Aircrew Training Manuals (ATMs)

During 1992 new ATMs incorporating crew coordination guidance were being published and distributed. Working Group members provided the project staff with up-to-date draft and final versions of each publication. This arrangement allowed for early consideration of the more detailed guidelines being issued to the field on how to implement crew coordination.

The revised ATM tasks explicitly identified crew coordination standards (e.g., correctly perform crew coordination actions) and described individual crewmember duties (e.g., pilot flying, pilot not flying, crew chief, etc.). Additionally, the crew coordination elements implied in each ATM task indicated the need to evaluate multiple aspects of crew coordination within a single ATM task.

Evaluation principles and grading considerations in each ATM stated that, "The guidelines for evaluating crew coordination are not based on objective criteria; for example, distance or degrees. Rather they are based on a subjective analysis of how effectively a crew performs together to accomplish a series of tasks. The subjective analysis is as important as the objective evaluation of the more definitive measurable tasks. The evaluator measures crew coordination skills on the basis of

subjective judgment, which is more difficult than objectively measuring the skill to accomplish a specific task" (chapter 8, ATMs). Guidelines on conducting the subjective analysis of crew coordination skills required that evaluators consider two criteria:

1. how effectively does each crewmember communicate, and

2. how effectively does each crewmember sequence and time critical actions to complete a task successfully.

Brief explanations of these still individual-oriented criteria included some language from the ATM crew coordination elements but did not directly refer to the elements or provide clear definitions to reduce subjectivity.

Grade slips in the new ATMs provided for recording performance at the rated and/or nonrated crewmember level (Maneuver/Procedure Grade Slip) and at the battle-rostered crew level (Battle-Rostered Crew Evaluation/Training Grade Slip). The Maneuver/Procedure Grade Slip covered all ATM tasks while the Battle-Rostered Crew Evaluation/Training Grade Slip allowed commanders to designate mission essential crew tasks. The aircrew grading system specified the use of satisfactory (S), unsatisfactory (U), or not applicable (NA) for both ATM tasks and commander designated crew tasks.

Crew Coordination Working Group

The Working Group provided the background information and detailed guidelines necessary to develop and document a method for evaluating crew coordination that implemented the new Training Circulars. Many of the Working Group members had directly participated in developing the new Commander's Guide and revised ATMs. They were familiar with the background and intended meaning of the concepts and guidelines contained in the new publications. The Working Group was fully qualified and authorized to both clarify and issue guidelines to develop an acceptable method for evaluating crew coordination performance.

Initial discussions with the Working Group clarified major points that guided development of the evaluation approach. The evaluation method had to be:

1. capable of measuring the effect of crew coordination training on both flight safety and effective mission performance,

2. consistent with the new Commander's Guide and the new ATMs for all Army aircraft--rotary and fixed wing, and

3. suitable for use in visual simulators and in the aircraft itself because visual simulators were not available for all platforms.

A priority for the Working Group was to supplement the Commander's Guide and ATMs with the seminal information needed to effectively teach and evaluate crew coordination. The Working Group reviewed contractor and other service developed courses of instruction and research reports on crew coordination. Findings in ARIARDA/DRC's past research (Simon, 1991) indicated a strong correlation between crew coordination behaviors and task performance. The Working Group made extensive use of the information contained in the Simon (1990,1991) research report. Initial actions compared the aircrew coordination elements described in the new ATMs with the crew coordination behaviors or dimensions from the Aircrew Coordination Evaluation (ACE) Checklist used in the 1990 experiment.

Over a series of meetings, the Working Group guided project staff to add, delete, and combine the ACE behavior titles and definitions to produce a set of 13 crew coordination behaviors called Basic Qualities. Written descriptions of superior, acceptable, and very poor performance were prepared for each Basic Quality definition. These behavioral descriptions were assigned values of seven, four, and one, respectively, to serve as anchors for a seven-point rating system. The Working Group specified that the Basic Qualities and the behaviorally anchored rating system (BARS) be central to the evaluation method.

From the outset, the Working Group stressed that the Army train crew coordination in the same manner as it planned to evaluate crew performance. The Basic Qualities composing the new ACE Checklist were then aligned and sequenced with the previously approved crew coordination objectives for use in organizing the training course content. This action effectively placed crew coordination training and evaluation on a common framework of crew coordination objectives, Basic Qualities, and performance standards. By design, training and evaluation share common terms, definitions, and descriptions of crew behaviors that implement the Army's new Aircrew Training Manuals.

Project staff met with the Working Group to discuss the adequacy of the new ATM grading procedures and grade slips to evaluate crew coordination performance. The Working Group specified that the Maneuver/Procedure Grade Slip for each aircraft be used to evaluate ATM tasks but agreed to consider modifications if needed to support the use of the Basic Qualities and behaviorally anchored rating system (BARS) measures. Project staff proposed minor changes to the grade slip and grading procedures to explicitly evaluate the crew coordination skills included in all ATM tasks. The Working Group approved the modifications but restricted the use of the Aircrew Coordination Training Grade Slip to initial and refresher crew coordination training only. The Battle-Rostered Crew Evaluation/Training Grade Slip would be used to evaluate crew coordination continuation training. The Working Group specified that instructor pilots and unit trainers be trained on the evaluation

method and its use in the crew coordination course of instruction. Table 3 summarizes the guidelines for evaluating crew coordination.

Table 3

Summary of Guidelines for Evaluating Crew Coordination

Evaluation Topic	Guidance (Source*)
Philosophy	• Define crew coordination (CG) • Emphasize crew rather than individual aviator performance (CG)
Approach	• Define the evaluation process (WG) • Ensure consistency to implement new Commander's Guide and ATMs (WG) • Measure crew coordination training effect on flight safety and mission effectiveness (WG) • Ensure suitability for use in all Army aircraft (rotary and fixed wing) and visual simulators (WG) • Focus on relationship between behaviors and performance (WG)
Attitude Measure	• Limit use to validation testbed evaluation package (WG)
Behavioral Measure	• Relate ACE behavioral dimensions to ATM crew coordination elements and objectives (WG, ATM) • Add, delete, and combine behavioral titles and definitions (WG) • Sequence crew coordination behaviors in mission execution order (WG) • Refer to crew coordination behaviors as Basic Qualities (WG) • Include example ATM tasks in Basic Quality definitions (WG, ATM) • Incorporate the 7-point behaviorally anchored rating scale (WG) • Revise behavioral anchor written descriptions (WG)
Grade Slips	• Modify the aircraft maneuver procedure grade slip and identify it as the Aircrew Coordination Training Grade Slip (WG, ATM) • Limit use of the Aircrew Coordination Training Grade Slip to crew coordination initial and/or refresher training (WG) • Include Battle-Rostered Crew Evaluation/ Training Grade Slip for overall performance and evaluator comments (WG, ATM) • Incorporate S+, S, S-, and U expanded grading system (WG)

Table 3

Summary of Guidelines for Evaluating Crew Coordination (Cont.)

Evaluation Topic	Guidance (Source*)
Scenarios	• Develop realistic tactical scenarios for evaluation missions (WG) • Provide video recording and playback to assist evaluators (WG) • Provide guidelines for scenario development (WG)
Mission Performance Measures	• Ensure objective comparison across crews to support overall mission performance (WG)
Evaluator Workbook	• Ensure that exceptions to ATM evaluation procedures are clearly stated (WG, ATM)
Interaction with Training Course	• Train instructor pilots and unit trainers on evaluation method and materials (WG) • Limit pre- and post-training evaluations to instructor pilots (WG)
Exit Interviews	• Provide for individual and group formats (WG) • Limit use to valiation testbed evaluation package (WG)

*Commander's Guide (CG), Aircrew Training Manual (ATM), Working Group (WG)

Development of the Validation Testbed Evaluation Package

This section describes the major activities undertaken to develop the validation testbed evaluation package and presents the evaluation products (see Figure 2).

Evaluation Requirements and Approach

Initially, the crew coordination validation testbed was to confirm the evaluation method and materials using AH-64 (priority) and UH-60 crews and visual simulators. The crew coordination Working Group subsequently deleted the AH-64 from the testbed due to scheduled modifications to the combat mission simulators and the unavailability of crews in the field units. Although the products were developed to evaluate utility helicopter crew operations in the validation testbed, they accommodate all Army aircraft--rotary and fixed wing.

Based on Working Group guidelines, methods and measures introduced in ARIARDA/DRC's past research (Simon, August 1990 and Simon, 1991) were selected as start points. DRC designed a methodology that measures the difference in performance within a

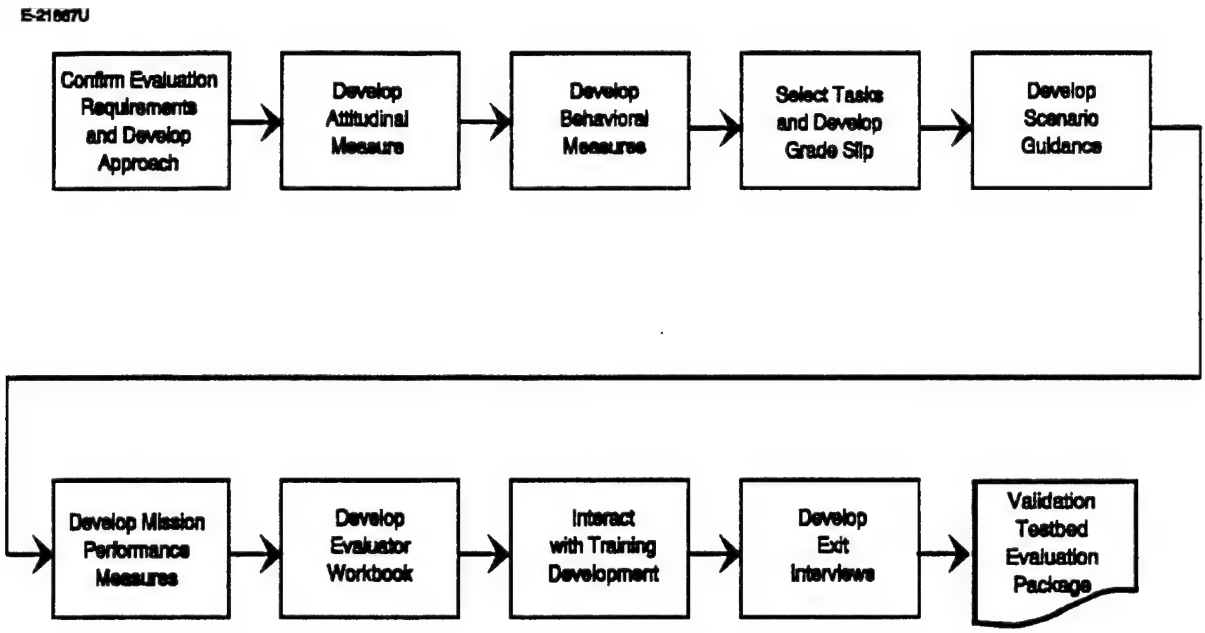

Figure 2. Evaluation methods and materials development.

group of crews before and after receiving crew coordination training. A testbed using Army aviation crews in their normal training environment was selected to:

1. validate the evaluation method itself, that is, unit instructor's understanding and ability to apply the method to produce objective, reliable evaluations of crew coordination, and

2. validate the Army's newly designed crew coordination training course.

Three levels of evaluation form the basis of the methodology (see Figure 3). At the first level, the methodology includes a questionnaire to assess individual crewmember attitudinal changes resulting from participation in crew coordination training. The second level addresses behavioral changes in the cockpit and includes independent measures consisting of behaviorally anchored rating scales and instructor pilot rating forms. The rating scales can be applied to all Army aircraft, whereas the rating forms are based on the new ATMs for each aircraft. At the third level, the methodology addresses flight safety and combat mission effectiveness.

Attitudinal Measure

An attitudinal measure was included in the validation testbed evaluation process for two reasons: to further explore the possible relationship between attitudes and task performance and to measure the pre- and post-training effect on crewmember attitudes toward crew coordination.

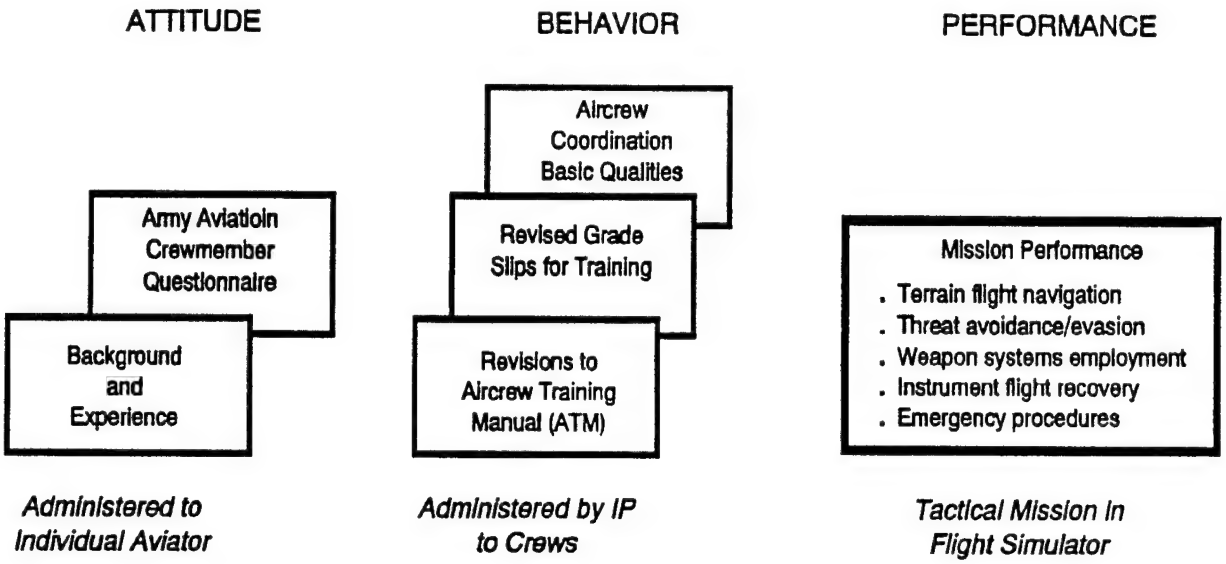

Figure 3. Levels of evaluation.

The attitudinal questionnaire, Army Cockpit Management Attitudes Questionnaire (CMAQ), used in the 1990 experiment served as the basis. The 45 item CMAQ was critically analyzed and revised. Instructions were revised to stress the importance of the Crew Coordination Program on aviation safety and mission effectiveness. The entire instrument was edited to accommodate all Army aircraft, remove references to commercial aviation, and incorporate current doctrine and training literature terms like crew readiness level and after-action review.

Analysis of the reliability of each item in the previous instrument was used to identify and eliminate 10 weak questions. Factor analysis of the remaining items, including questions from the NASA-University of Texas attitude survey of commercial airline and Air Force crews, resulted in a three-factor model (Simon, 1991) that best explained the variance in responses. The number of questions in the Communication and Coordination, Shared Leadership, and Recognition of Stressor Effects factor scles was considered when revising previous items and creating new items. Previous items were revised and new items were created to address new subject areas like premission planning and rehearsal and after-action review that were being included in the Crew Coordination Exportable Training Package (Pawlik, Simon, Grubb, & Zeller, 1992).

A scoring key was prepared for the 46 items to help sequence and balance the overall instrument. Additionally, items were balanced within factors and sequenced to avoid concentrating a series of questions that addressed a single factor in one area of

the questionnaire. ARIARDA reviewed and approved the questionnaire. The final attitudinal measure is at Appendix A.

Behavioral Measures

The crew coordination Working Group endorsed crew behaviors as the principal means to teach and evaluate crew coordination making this an especially important measure. Products developed to evaluate crew coordination behaviors include behavioral measures, a rating scale, and guidelines on how to rate crew performance.

The initial action to develop behavioral measures was to review the results of the 1990 experiment's Aircrew Coordination Evaluation (ACE) Checklist (Simon, 1991). Reliabilities were exceptionally high for the 19 behavioral items found in the 1990 ACE Checklist. Item analysis placed each of the crew coordination behaviors or "dimensions" into one of five behavioral domains, that is, four separate domains and a total. The four crew coordination domains were:

1. establish/maintain team relationships,

2. cross monitoring of crew performance,

3. mission information exchange, and

4. establish/maintain reasonable workload levels.

After additional research and analysis, the project staff made the following changes:

1. Add mission planning and rehearsal as a domain.

2. Delete ACE dimensions (3) Inquiry/questioning practiced, (15) Overall technical proficiency, (16) Overall crew effectiveness, and (17) Overall workload.

3. Combine dimensions (5) Decisions communicated and acknowledged and (6) Actions communicated and acknowledged into a new dimension (5) titled Decisions and actions communicated and acknowledged.

4. Retitle dimension (18) Conflict resolution to read Resolution of disagreements.

5. Add premission rehearsal accomplished as a dimension.

The revised behavioral domains and set of ACE behaviors were compared with the aircrew coordination objectives and elements described in the new ATMs. Based on published definitions, relationships were established with all 5 behavioral domains and 11 of the 15 ACE dimensions.

The Working Group guided project staff to add, delete, and combine the behavior titles and definitions to produce a set of 13 crew coordination behaviors called Basic Qualities. The Basic Qualities composing the new ACE Checklist were then sequenced and aligned with the published objectives for the Army's Crew Coordination Program. Figure 4 illustrates the relationship of Basic Qualities to ATM crew coordination elements and crew coordination program objectives. The Working Group encouraged the use of the chart in the training course to enable crewmembers to recognize and understand a clear linkage or "crosswalk" among the related crew coordination terms.

The former ACE dimensions were revised to incorporate the new Basic Quality titles and structure. Behavioral measures were created for the new Basic Qualities, that is, establish and maintain flight team leadership and crew climate, application of appropriate decision making techniques, and crew-level after-action review accomplished. Abbreviated title identifiers were prepared to facilitate use of the Basic Qualities in related evaluation materials like grade slips and evaluator worksheets.

The Basic Quality definitions and descriptions of the types of behaviors for superior, acceptable, and very poor levels of performance were revised and extended to include example tasks from the new ATMs. The written descriptions of the levels of performance for each Basic Quality definition were assigned values of seven, four, and one to serve as anchors for a seven-point rating system. The Working Group specified that the Basic Qualities and the behaviorally anchored rating system (BARS) be central to the evaluation process. The numeric rating scale shown below was developed for evaluators to assess the level of behavior that crews exhibited for each Basic Quality.

Very Poor	Poor	Marginal	Accept-able	Good	Very Good	Superior
1	2	3	4	5	6	7

Guidelines were prepared to assist evaluators in assessing how well a crew performed each Basic Quality in relation to the ACE Checklist's behavioral anchors. For example, in completing a basic quality rating, evaluators should decide whether the behaviors observed fall into the low end of the basic quality range (values 1 or 2), the middle of the range (values 3, 4, or 5), or the high end of the range (values 6 or 7). Once the general range of response is selected, use the anchors to help select the final rating value. Cautions included in the guidelines emphasized that evaluators should use the behavioral anchors as the standard for making ratings and avoid lapsing into rating crews in comparison to one another.

ATM Aircrew Coordination Elements									Crew Coordination Objectives				
Communicate Positively	Direct Assistance	Announce Actions	Offer Assistance	Acknowledge Actions	Be Explicit	Aircraft Control and Obstacle Advisories	Action Sequence/Timing	Aircrew Coordination Basic Qualities	Establish and Maintain Team Relationships	Mission Planning and Rehearsal	Establish and Maintain Workload Levels	Exchange Mission Information	Cross Monitor Performance
								1. Establish and maintain flight team leadership and crew climate	XX				
							X	2. Pre-mission planning and rehearsal accomplished		XX			
	X							3. Application of appropriate decision making techniques		XX	X		
	X		X					4. Prioritize actions and distribute workload			XX		
			X			X		5. Management of unexpected events	X		XX		
XX				X				6. Statements and directives clear, timely, relevant, complete, and verified				XX	
X								7. Maintenance of mission situational awareness				XX	
		XX		XX				8. Decisions and actions communicated and acknowledged				XX	
	XX							9. Supporting information and actions sought from crew			X	XX	
		XX				XX		10. Crewmember actions mutually cross monitored					XX
		XX						11. Supporting information and actions offered by crew			X		XX
		XX						12. Advocacy and assertion practiced				X	XX
								13. Crew-level after action reviews accomplished					XX

Figure 4. Aircrew coordination Basic Qualities and their relationships to ATM Aircrew Coordination Elements and Crew Coordination Objectives.

Working Group members were concerned about the ability of instructor-evaluators to effectively interpolate and apply the behavioral anchors to determine ratings. As a result, a more structured method of decomposing and scoring the Basic Qualities was provided to evaluators for use as an alternative to the behavioral anchors. The Crew Coordination Debriefing and Rating Guide (Optional) decomposed each Basic Quality into a set of issues for the evaluator to focus on during the mission. For each issue, the guide posed a series of questions regarding different aspects of observable performance along with three general answers to each question reflecting the levels of performance: superior, acceptable, and very poor. The method permitted evaluators to compute an average score for each issue associated with a Basic Quality and an overall score for the Basic Quality itself.

The Basic Qualities and behavioral anchors, rating scale, and rating guidelines are shown in Appendix B.

Note: The discussion of major activities to develop the testbed evaluation package transitions at this point from general topics supported by aviation-wide examples to more specific topics illustrated by UH-60 unique examples used in the testbed itself. The more specific topics, like ATM tasks, address the details necessary to implement the crew coordination evaluation method for aircrews flying any Army aircraft. For example, the discussion on ATM tasks and grade slips applies to all aircraft, but only the UH-60 rated crew member grade slip developed for the testbed is shown.

ATM Tasks and Grade Slips

The testbed evaluation package included crew performance of aircraft specific tasks. The new ATMs, with crew coordination duties specified, served as the source of tasks to include in the validation testbed. The AH-64 and UH-60 draft ATMs were reviewed to select crew coordination intensive tasks that could be included in a tactical scenario for evaluation in a visual flight simulator. Tasks like navigation, target acquisition and engagement, threat evasion, external loads, and instrument flight were selected and reviewed by instructor pilots and simulator operators for suitability to evaluate crew coordination.

Initial guidance was to develop crew coordination training and evaluation materials that implemented the new ATMs. Project staff met with the crew coordination Working Group to discuss the adequacy of the new ATM grade slips and grading procedures to evaluate crew coordination performance. The Working Group specified that the Maneuver/Procedure Grade Slip for each aircraft be used to evaluate ATM tasks but agreed to consider modifications if needed to support the use of the ACE Checklist Basic Qualities and behaviorally anchored rating system (BARS) measures.

Project staff analyzed the new ATMs and developed a set of modifications to the grade slips and grading system for Working Group approval. Modifications were developed based on the AH-64 ATM and then applied to the UH-60 aircraft for validation in the crew coordination testbed. The modifications were developed to be applicable to all Army aircraft.

The Maneuver/Procedure Grade Slip was modified to provide more space for crewmember information, multiple entries in the grade block for each task, and a look-up table of crew coordination Basic Qualities at the bottom of each page. A grade block was provided to enter a summary rating (BARS scale numbers 1, 2, ...7) for each Basic Quality at the bottom of the last page. Minor modifications to the instructions for use of the Battle-Rostered Crew Evaluation/Training Grade Slip, introduced in the new ATMs, were developed to accommodate crew coordination grading requirements. The modified instructions substituted the Aircrew Coordination Training Grade Slip for the list of crew tasks and applied an expanded grading system, described below, to the overall flight grade. Use of this grade slip in conjunction with the Aircrew Coordination Training Grade Slip provided a link between initial and/or refresher crew coordination training and the unit's continuation training.

Modifications included an expanded grading system for crew coordination training that includes both the technical and crew coordination aspects of each ATM task. The modification expands the current satisfactory (S) or unsatisfactory (U) grading system to provide more precise evaluation of crew coordination strengths and weaknesses by breaking the satisfactory grade into satisfactory plus (S+), satisfactory (S), and satisfactory minus (S-) grades. Written guidance to implement the expanded grading system includes specifics to identify the crew coordination Basic Qualities (numbers 1, 2, ...13), if any, that contributed to less than satisfactory ATM task performance. The grading guidelines provided instructions to make a written comment for tasks graded S+ or U, to make a summary rating for each Basic Quality, and to grade the overall flight.

The Working Group approved the modifications for evaluating crew coordination but restricted the Aircrew Coordination Training Grade Slip to initial and refresher crew coordination training only. Instructions on the grading system and reproducible blanks of the final Aircrew Coordination Training Grade Slip (See Figure 5) were included in the Crew Coordination Exportable Training Package (Pawlik, Simon, Grubb, & Zeller, 1992).

Scenario Guidance

Discussions with the crew coordination Working Group and detailed reviews of current Army publications, including the new ATMs, emphasized the importance of developing realistic tactical situations to accurately assess crew performance.

MANEUVER/PROCEDURE GRADE SLIP FOR UH-60 RCM

For use of this form, see Aircrew Coordination Exportable Training Package and TC 1-212

PC _____ Date _____

PI _____

Instructor or evaluator will sign in the first unused block.

NO	MANEUVER/PROCEDURE	GR	NO	MANEUVER/PROCEDURE	GR
1	CREW MISSION BRIEFING		27	EMERGENCY EGRESS	
2	VFR PLANNING		28	EMERGENCY PROCEDURES	
3	IFR FLIGHT PLANNING		29	HAND AND ARM SIGNALS	
4	DD FORM 365-4		30	FUEL SAMPLE	
5	DA FORM 5701-R		31	PASSENGER BRIEFING	
6	PREFLIGHT INSPECTION		32	INSTRUMENT TAKEOFF	
7	BEFORE-STARTING ENGINE THROUGH AIRCRAFT SHUTDOWN		33	RADIO NAVIGATION	
8	ALSE OPERATION		34	HOLDING PROCEDURES	
9	GROUND TAXI		35	UNUSUAL ATTITUDE RECOVERY	
10	HOVER POWER CHECK		36	RADIO COMMUNICATION PROCEDURES	
11	HOVERING FLIGHT		37	PROCEDURE FOR TWO-WAY RADIO FAILURE	
12	VMC TAKEOFF		38	NONPRECISION APPROACH	
13	TRAFFIC PATTERN FLIGHT		39	PRECISION APPROACH	
14	FUEL MANAGEMENT PROCEDURES		40	INADVERTENT IMC/VHIRP	
15	PILOTAGE AND DEAD RECKONING		41	COMMAND INSTRUMENT SYSTEM OPERATIONS	
16	ELECTRONIC-AIDED NAVIGATION		42	A/C SURVIVABILITY EQUIPMENT	
17	VMC APPROACH		43	MARK XII IFF SYSTEM	
18	ROLL-ON LANDING		44	CONFINED AREA OPERATIONS	
19	SLOPE OPERATIONS		45	PINNACLE OR RIDGELINE OPERATION	
20	AIRCRAFT REFUELING		46	FM RADIO HOMING	
21	POSTFLIGHT INSPECTION		47	EVASIVE MANEUVERS	
22	SIMULATED ENGINE FAILURE AT ALT		48	MULTIAIRCRAFT OPERATIONS	
23	SIMULATED ENGINE FAILURE AT		49	RAPPELLING OPERATIONS	
24	DEGRADED AFCS		50	INTERNAL RESCUE-HOIST OPERATIONS	
25	ECU LOCKOUT OPERATIONS		51	PARADROP OPERATIONS	
26	STABILATOR MALFUNCTION PROC		52	STABILITY OPERATIONS	

AIRCREW COORDINATION BASIC QUALITIES

1. CREW CLIMATE	2. PLAN REHEARSE	3. DECISION TECH	4. WORK LOAD	5. UNEXP EVENTS	6. INFO XFER	7. SIT AWARE	8. COMM ACK	9. INFO SOUGHT	10. CROSS MONITOR	11. INFO OFFERED	12. ADVOC/ ASSERT	13. AAR

AIRCREW COORDINATION TRAINING GRADE SLIP

Figure 5. Aircrew coordination training grade slip (page 1 of 2).

MANEUVER/PROCEDURE GRADE SLIP FOR UH-60 RCM

NO	MANEUVER/PROCEDURE	GR	NO	MANEUVER/PROCEDURE	GR
53	EXTERNAL LOAD OPERATIONS		79		
54	INTERNAL LOAD OPERATIONS		80		
55	AERIAL RADIO RELAY		81		
56	ACTIONS ON CONTACT		82		
◇57	TERRAIN FLIGHT MISSION PLANNING		83		
◇58	TERRAIN FLIGHT NAVIGATION		84		
◇59	TERRAIN FLIGHT		85		
60	WIRE OBSTACLES		86		
61	MASKING AND UNMASKING		87		
62	TERRAIN FLIGHT DECELERATION		88		
63	MAJOR US/ALLIED AND THREAT EQUIPMENT IDENTIFICATION		89		
64	TACTICAL COMMUNICATION PROCEDURES AND ECCM		90		
65	TACTICAL REPORT		91		
66	QUICK FIX MISSION		92		
67	FLAT TURN/VCALIBRATED FLIGHT		93		
68	ORAL EVALUATION		94		
69			95		
70			96		
71			97		
72			98		
73					
74					
75					
76					
77					
78					

NOTES:

◇ NVD MANEUVER
□ INSTRUMENT MANEUVER
○ STANDARDIZATION MANEUVER

ENTER S+, S, S-, OR U IN GRADE BLOCK. IF GRADE IS S- OR U DUE TO AIRCREW COORDINATION INCLUDE UP TO TWO BASIC QUALITY NUMBERS.

S- 2,5

AIRCREW COORDINATION BASIC QUALITIES

	1. CREW CLI-MATE	2. PLAN RE-HEARSE	3. DECI-SION TECH	4. WORK LOAD	5. UNEXP EVENTS	6 INFO XFER	7. SIT AWARE	8 COMM ACK	9 INFO SOUGHT	10. CROSS MON-ITOR	11 INFO OF-FERED	12. ADVOC/ ASSERT	13. AAR
GRADE													

PAGE 2, AIRCREW COORDINATION TRAINING GRADE SLIP

Figure 5. Aircrew coordination training grade slip (page 2 of 2).

Project staff researched the adequacy of existing preplanned scenarios maintained by flight simulator facilities and the published guidance on developing scenarios. The diverse missions and level of detail in the preplanned scenarios made them unusable for the testbed without major modifications. Guidance on scenario development published in doctrine and training literature was too broad to apply without interpretation. The need to provide guidance on how to develop tactical scenarios was confirmed by visits to units in the field. As a result, two tactical scenarios for UH-60 equipped units were prepared for the validation testbed evaluation package.

The scenarios were methodically developed to realistically illustrate the primary missions, conditions, and situations needed to evaluate crew coordination mission performance areas and tasks. Detailed outlines to identify mission segments, tactical events, and ATM tasks were prepared to document the scenario development-evaluation process. Tactical realism was ensured by preparing detailed air mission briefings for the crews, narrative scripts for simulator operators, instructions to assist simulator operators program the scenario, and written guidance to assist crew coordination evaluators. The requirements considered, steps taken, information sources accessed, and formats that the project staff used to document the validation testbed scenarios constitute the scenario guidance materials for evaluating crew coordination. These materials are also included in the Crew Coordination Exportable Training Package (Pawlik, Simon, Grubb, & Zeller, 1992).

Both general and specific requirements were developed for scenarios and situational training exercises to be used in flight simulators and aircraft, respectively. The following general requirements to support crew coordination evaluation were reviewed and approved by the Working Group:

1. Focus on unit's mission essential task list (METL).

2. Be consistent with the guidance for crew training contained in TC 1-210, Aircrew Training Program, Commander's Guide to Individual and Crew Training Program, and the appropriate ATM.

3. Involve battle-rostered crews. Note: Guidelines in TC 1-210 establish the requirement for commanders to battle roster crews. The USAAVNC prescribes that battle rostered crews fly together at least once every 180 days. The USAAVNC guidance assumes that battle rostering promotes the development and maintenance of effective crew coordination. However, crews participating in the validation testbed had not yet been battle rostered by their unit.

4. Emphasize crew tasks developed as a part of the unit's collective training.

Specific requirements were included to establish the amount of time, types of events, degree of difficulty, desirability of video recording, and evaluator duties for crew coordination evaluation scenarios.

Materials were prepared to document the suggested steps and products from each step in developing a crew coordination evaluation scenario.

1. Select a common tactical mission(s). Materials include Table 4, Missions of Army Aviation Aircraft.

2. Identify unit mission essential tasks.

3. Incorporate activities and ATM tasks that emphasize crew coordination.

4. Develop a scenario outline (See Table 5).

5. Identify activity breakpoints and describe the major activities and focus for each scenario segment (See Table 6).

6. Select ATM tasks.

7. Transpose scenario outline to the tactical training area available.

8. Develop an OPORD and/or an air mission briefing to include a simulator operator script for simulator scenarios.

A checklist of scenario-based materials was developed as a guide for evaluators to instill a sense of unit mission and mission planning realism to crew coordination evaluations (see Table 7). Visits to units in the field provided a forum for review of the scenario development guidance materials for their suitability to evaluate crew coordination.

Mission Performance Measures

The new ATMs emphasized that research has shown direct, positive effects of crew coordination on flight safety and mission performance. For this reason, actions were taken to include measures of mission performance in the crew coordination validation testbed design. Thus, a set of mission performance measures was developed to extend the evaluation of crew performance of ATM tasks to overall mission performance.

Measures of mission performance captured via data extrapolated from video tapes of crew missions in a flight simulator and reported in previous research (Simon, 1991) showed that a positive correlation exists between crew coordination and mission performance. The mission performance measures used in the 1990 experiment were navigation, threat encounters, and instrument approach procedures.

Table 4

Missions of Army Aviation Aircraft[a]

Mission	Roles	Aircraft
Observation Observation helicopters perform visual observation and target acquisition.	- Reconnaissance (route, area, zone) - Security (cover, guard, screen) - Command, control, communications, and intelligence enhancement - Aerial adjustment of field artillery - Surveillance - NBC reconnaissance - Laser designation for precision guided munitions (OH-58D only)	OH-6A, OH-58A, OH-58C, OH-58D, and RAH-66
Attack The primary mission of attack helicopters is to destroy enemy armored, mechanized, and helicopter forces.	- Antiarmor - Antipersonnel - Air combat - Suppression of enemy air defenses - Joint air attack team operations - Joint second echelon attack - Antimateriel - Laser designation for precision guided munitions (AH-64 only)	AH-64, RAH-66, AH-1E, AH-1S, AH-1P, AH-1F, and UH-1M
Utility Rotary wing Utility helicopters perform a variety of missions to include air assault, air movement, command and control, and MEDEVAC operations.	- Air assault and combat assault of combat forces - Air movement of supplies, equipment, and personnel - Aerial evacuation of equipment, casualties, and prisoners of war - Aerial delivery of scatterable mines and sensors - Combat search and rescue - Command, control, communications, and intelligence enhancement	UH-1H, UH-1V (MEDEVAC), and UH-60A
Fixed wing Utility fixed-wing aircraft are employed to move personnel and equipment and to support commanders and their staffs.	- Command, control, communications, and intelligence enhancement - Administration - Liaison - Aeromedical evacuation	U-21A, C-12A/C, UV-18A, and C-20
Cargo Cargo helicopters perform a variety of missions from air movement of combat power to air movement of troops and cargo.	- Air-move combined arms forces and equipment - Emplace field artillery and other fire support assets - Reposition tactical air defense weapons and systems - Perform medical evacuation - Move combat power, troops, logistical supplies, and equipment forward, laterally, and rearward - Perform logistics over-the-shore operations - Air-move conventional, nuclear, and chemical munitions	CH-47A, CH-47B, CH-47C, CH-47D, CH-54A, and CH-54B

Table 4

Missions of Army Aviation Aircraft[a] (Cont.)

Mission	Roles	Aircraft
Special electronic mission aircraft Special electronic mission aircraft perform a variety of intelligence and electronic warfare operations.	- Process and relay high value intelligence information to maneuver commanders - Provide communications intelligence - Provide electronic collection - Collect, process, and analyze infrared, radar, and photographic imagery - Support deception operations to deceive and deny critical combat information to enemy forces - Provide direction finding, interception, and jamming of communications emitters	EH-1, EH-60, RV/OV-1, RU-21, and RC-12
Special Operations Aviation SOA aircraft perform a variety of missions to support special operations forces.	- Clandestinely penetrate denied enemy areas - Assault, resupply, insert, or extract SOF - Conduct aerial security, reconnaissance, surveillance, and electronic warfare support of special operations missions - Provide airborne command, control, and communications enhancement - Support coordinated and synchronized joint, combined, or host-nation special operations - Perform aircraft strategic self-deployment operations - Perform limited aeromedical evacuation - Perform search and rescue operations - Conduct aerial mine delivery operations - Perform general aviation support missions, as necessary	MH-6, AH-6, MH-60K, and MH-47E

[a]Source: FM 1-100, Doctrinal Principles for Army Aviation in Combat Operations, February 1989

Table 5

Air Assault & Air Movement Scenario Outline

Segment	Performance measures	ATM tasks
1. Pre-mission Planning	Mission Planning & Rehearsal Mission briefing/brief-back	2078-terrain flt msn plan 1004-PPC 1000-Mission brief
2. AA to PZ	Material malfunction (major)	1007-Start/run-up 1016-Hover pwr ck 1018-VMC takeoff 1026-Elect-aided nav 2079-Terrain flt nav 2081-Terrain flt 1023-Fuel mgt proced 1068-Emergency 1095-Operate ASE 2008-Evasive maneuvers 1028-VMC approach
3. PZ to LZ to PZ	Navigation (corridors) Time to fly segment Time of arrival Threat avoidance & evasion Material malfunction (minor)	1016-Hover pwr ck 1018-VMC takeoff 2009-Multiaircraft opns 1026-Elect-aided nav 2079-Terrain flt nav 2081-Terrain flt 1023-Fuel mgt proced 1095-Operate ASE 2008-Evasive maneuvers 1028-VMC approach
4. PZ to LZ to PZ	Navigation (corridors) Time to fly segment Threat avoidance & evasion	2016-External load opns 1016-Hover pwr ck 1018-VMC takeoff 1026-Elect-aided nav 2079-Terrain flt nav 2081-Terrain flt 1023-Fuel mgt proced 1095-Operate ASE 2008-Evasive maneuvers 1028-VMC approach
5. PZ to AA	Inadvertant IMC Instrument recovery	1018-VMC takeoff 1026-Elect-aided nav 2079-Terrain flt nav 2081-Terrain flt 1023-Fuel mgt proced 1095-Operate ASE 2008-Evasive maneuvers 1083-VHIRP 1076-Radio nav 1081-Non precision appr

Table 6

Scenario Segment Information

Segment 1: Premission planning

Description: The premission planning segment begins when the crew receives the mission briefing and includes all preparatory tasks associated with planning the tactical mission. These tasks include terrain flight mission planning, performance planning, assigning crewmember responsibilities, and all required briefings and brief-backs. The segment ends when the crew completes all required briefings and prepares to enter the simulator.

Segment 2: Movement from the assembly area (AA) to the initial pick-up zone (PZ)

Description: The segment begins when the crew enters the simulator and verifies that initial start and run-up procedures are complete. During this segment, the crew repositions the aircraft from the AA to the initial PZ in preparation for an air assault mission. The segment includes an emergency caused by an aircraft system malfunction which should result in a precautionary landing in the PZ. The segment ends when the crew completes the precautionary landing.

Segment 3: Cross-FLOT air assault mission

Description: The segment begins when the troops have been loaded on the aircraft. It involves moving troops along a prescribed route in a medium-to-high threat environment, delivering them to the LZ, and then returning to the PZ. The crew will act as flight lead for a flight of 5 UH-60 helicopters with no changes in lead or formation. The crew must accurately navigate within prescribed corridors while avoiding and evading threat to deliver the troops to the correct location at the correct time. The segment includes a minor malfunction which will be removed as soon as the crew detects and *verbally recognizes* the malfunction. The segment ends when the crew returns to the PZ.

Segment 4: External load air movement mission

Description: The segment begins when the crew takes off to pick up the external load. It involves moving an external load along a prescribed route in a medium-to-high threat environment to resupply a friendly unit located near the forward line of troops (FLOT). The crew must accurately navigate within prescribed corridors while avoiding and evading threat to deliver the external load to the correct location. The crew then returns to the PZ in preparation for a follow-on mission. The segment ends when the aircraft returns to the PZ.

Segment 5: Movement from the PZ to the assembly area

Description: The segment begins when the aircraft departs the PZ enroute back to the AA. During the flight, the crew encounters an inadvertent entry into instrument meteorological conditions (IMC). The crew must then plan and execute a nonprecision instrument approach to transition back to visual meteorological conditions (VMC). The segment ends when the crew completes a safe landing.

Table 7

Scenario Materials

Scenario item	Student	Instructor	Simulator operator
OPORD and/or air mission briefing[1]	X	X	X
Scenario outline		X	X
Scenario segment info		X	X
Tactical map	X	X	X
Approach plate	X	X	X
Grade slip		X	

[1]Provide an instructor operator script for simulator scenarios.

flight simulator. After discussions with simulator operators and instructor pilots, the mission performance measurement areas listed below were selected to evaluate crew coordination in the validation testbed.

1. Terrain flight navigation. Scenario mission requirements demanded close compliance with specific flight routes and schedules.

2. Threat avoidance and evasion. Enemy situation in the scenario included different enemy anti-aircraft systems.

3. Aircraft emergencies. Scenario-related aircraft malfunctions were programmed to occur during the mission.

4. Unexpected event. Visibility and weather conditions, forecast to deteriorate throughout the mission, were adjusted to create inadvertent instrument meteorological conditions.

5. Instrument flight recovery. Aircraft and landing site equipment availability were reduced to require a non-precision instrument approach procedure.

6. Mission threatening crew error. Potential accident and/or injury situations were presented throughout the scenario.

Doctrinal, training, and equipment publications were used to develop specific performance measures within each mission area. Written descriptions were prepared to detail what to measure, how to collect measurement data, and parameters or metrics for each performance measure. For example, five specific performance measures were developed for Terrain Flight Navigation (see Table 8). Expanded descriptions of the data elements for each metric

Table 8

Terrain Flight Navigation Performance Measures

What to measure	How to collect	Measurement parameters
Number (N) of deviations from the corridor due to misorientatio	FS printout, page 25, "Cross country map" (12 x 12 K or 24 x 24 K) with ground track trace; verified by video tape review	Sum (N)
Distance of deviation outside of corridor due to misorientation	FS printout, page 25, "Cross country map" (12 x 12 K or 24 x 24 K) with ground track trace; verified by video tape review Sum (N)	Sum (N) <500m Sum (N) >500m <1500m Sum (N) >1500m
Deviation (seconds) from required time of arrival at landing zone	Live observation/time on tape	Actual time compared to time designated in OPORD/FRAG
Number (N) of mission (route) segments completed	Live observation; FS printout	Sum (N)
Time (sec) to fly each mission segment	Live observation/time on tape	Actual time compared to time designated in OPORD/FRAG

Analysis of the Mission Training Plan (MTP) missions for attack and utility helicopter units guided the identification of mission performance areas and helped to define specific mission performance measures for evaluation. Potential mission performance areas were studied to ensure that they could be realistically included in scenario segments and evaluated in a were prepared to support the testbed data collection and analysis efforts.

Instructor pilot-evaluators reviewed these measures for suitability as they evaluated their crews and collected data on measures like aircraft emergencies and unexpected events during the crew coordination testbed. More complete written descriptions of the crew coordination mission performance measures used in the testbed are at Appendix D.

Evaluator Workbook

The addition of crew coordination actions to ATM task standards placed an increased demand on individual evaluator's full attention. Data collection techniques for the crew coordination validation testbed required that instructor pilot-evaluators augment the project staff's direct observation and collection of specific mission performance measures. A means was needed to allow evaluators to collect mission performance data without diverting their attention from the primary task of evaluating crew performance.

An Evaluator Workbook was developed to organize the evaluator's questionnaire, grade slips, ACE Checklist behavioral measures and other materials in the same order that they would be refered to during the evaluation process. Previous experience with similar data collection requirements guided the development of a worksheet to facilitate rapid and accurate recording of evaluator entries. Evaluator worksheets were developed to permit circle or fill-in type entries for crew coordination performance and data collection items.

Organized by mission segments, the evaluator worksheets were developed in accordance with the outline for each scenario. A separate text block was used for each worksheet topic to help evaluators scan and locate desired information quickly. Topic blocks were arranged in scenario outline sequence (see Table 9).

1. Segment number. This block includes the segment title and a description of the events that begin and end the segment, including mission performance measure related events.

2. ATM task block. The ATM task block provides evaluators with preprinted grade and rating options for each task. Blank space is provided for evaluator notes. Circle or fill-in responses for data collection events are printed in bold characters.

3. Segment overall. The last block in a mission segment, this topic presents criteria to evaluate the crew's performance of this segment as if it were a separate mission.

4. Basic Qualities reference. Located at the bottom of each worksheet page, this block displays the Basic Quality short titles for reference.

Table 9

Evaluator Worksheet

SEGMENT 5: Movement from the PZ to the assembly area.

DESCRIPTION: The segment begins when the aircraft departs the PZ enroute back to the AA. During the flight, the crew encounters an inadvertent entry into instrument meteorological conditions (IMC). The crew must then plan and execute a nonprecision instrument approach to transition back to visual meteorological conditions (VMC). The segment ends when the crew completes a safe landing.

TASK 1018 Perform VMC takeoff

GRADE: S+ S S- U Basic Qualities: ___, ___

NOTES:

TASK 1026 Perform electronic-aided navigation

GRADE: S+ S S- U Basic Qualities: ___, ___

NOTES:

TASK 2079 Perform terrain flight navigation

GRADE: S+ S S- U Basic Qualities: ___, ___

NOTES:

AIRCREW COORDINATION BASIC QUALITIES												
1. CREW CLI-MATE	2. PLAN RE-HEARSE	3. DECI-SION TECH	4. WORK LOAD	5. UNEXP EVENTS	6. INFO XFER	7. SIT AWARE	8. COMM ACK	9. INFO SOUGHT	10. CROSS MONI-TOR	11. INFO OF-FERED	12. ADVOC/ ASSERT	13. AAR

Table 9

Evaluator Worksheet (Continued)

SEGMENT 5: (Concluded)

TASK 1083 Perform inadvertent IMC procedures/VHIRP

GRADE: S+ S S- U Basic Qualities: ___, ___

NOTES:

- VHIRP steps accomplished? ___ of 5

TASK 1076 Perform radio navigation

GRADE: S+ S S- U Basic Qualities: ___, ___

NOTES:

- Number of heading deviations > +/- 5 degrees? ___

- Number of altitude deviations > +/- 100 feet? ___

TASK 1081 Perform nonprecision approach

GRADE: S+ S S- U Basic Qualities: ___, ___

NOTES:

- Inbound leg of approach properly timed? Yes/No (Circle one)

SEGMENT 5 OVERALL Crew's ability to cope with inadvertent entry into instrument meteorological conditions and their ability to plan and execute a non-precision instrument approach.

GRADE: S+ S S- U Basic Qualities: ___, ___ (OPTIONAL)

NOTES:

AIRCREW COORDINATION BASIC QUALITIES												
1. CREW CLI-MATE	2. PLAN RE-HEARSE	3. DECI-SION TECH	4. WORK LOAD	5. UNEXP EVENTS	6. INFO XFER	7. SIT AWARE	8. COMM ACK	9. INFO SOUGHT	10. CROSS MONI-TOR	11. INFO OF-FERED	12. ADVOC/ ASSERT	13. AAR

Instructor pilot-evaluators used the evaluator worksheets during the validation testbed to record information for grade slip, crew debriefing, and mission performance data collection purposes. The Evaluator Workbook was a prototype of the Crew Coordination Exportable Evaluation Package described later in this report.

Interaction with Training Course Development

The Army's Crew Coordination Program for aviation depends largely on instructor pilots who train their crews in field units. Course development discussions emphasized the need to apply classroom instruction to the tasks that crews perform in a typical mission environment. As a result, two training evaluation flights in a visual simulator or an aircraft were designed into the validation testbed training course. Additionally, two evaluation flights, one pre-training and one post-training, were included in the validation testbed schedule. The post-training evaluation flight was considered the course completion examination.

Army Research Institute (ARI) emphasized the need for the training and evaluation to be conducted within identical frameworks. Direct participation in the design and development of the crew coordination training package ensured that the evaluation process supported the training strategy and addressed the specific crew coordination learning objectives. See the Development of Candidate Crew Coordination Training Methods and Materials technical report for details.

Project staff proceeded to develop instructional materials, case study examples, and practice exercises to teach instructor pilot-evaluators and unit trainers about the evaluation method and how to use the evaluation materials. Specific sections provided the following instruction to crew coordination evaluators:

1. Evaluation Procedures and Scenario Development. Procedures for assessing crew coordination performance and guidelines for developing scenarios.

2. Aircrew Coordination Training Grade Slips. Describes the grade slips and the expanded grading system for aircrew coordination training.

3. Aircrew Coordination Evaluation Workshop Exercises. Provides evaluators with classroom exercises to recognize and evaluate crew coordination performance.

4. Aircrew Coordination Evaluation Process. Provides a summary of evaluation actions to include video recording options.

5. Scenario Guidance. Provides specific guidance and examples to develop scenarios for visual flight simulators and

situational training exercises for crew coordination evaluations conducted in aircraft.

6. Scenario Familiarization and Evaluation. Familiarizes evaluators with a complete simulator scenario and provides experience evaluating crews in the simulator or aircraft.

Course materials used to train evaluators were rehearsed with the crew coordination Working Group to ensure clarity and completeness of the evaluation process and to gain their approval.

Exit Interviews

Participant debriefings were considered an integral part of the validation testbed evaluation package. Two exit interviews were constructed. One exit interview was constructed for the participating aircrews and the other was for the participating instructor pilots and unit trainers. Project staff drafted the initial exit interviews based on questions previously used in the interviews conducted during the 1990 crew coordination experiment. Both interviews were reviewed and approved by the crew coordination Working Group.

The general sections in the crewmember exit interview asked for feedback on administrative aspects of the course, the structure and presentation of the course of instruction, the flight simulator portion of the training, and general observations regarding the adequacy and worthiness of the training program. The evaluators and trainers were asked for feedback about the adequacy of the course of instruction that they received and then used to teach the aviators, the scenarios used during the evaluation phase, the evaluator's workbook, their use of the Basic Qualities and the modified grade slips, and general observations regarding the training and evaluation process used in the validation testbed.

Both interviews were designed to be group administered; however, instructors were also interviewed one-on-one and then later as a group. To expedite the interview process, participants were given the interview questions several days prior to the scheduled interview. For each of the five two-hour group-administered interviews, eight participants composed of four aircrews or the instructor cadre took part in any one session.

The exit interviews, "Aircrew Coordination Training Validation Testbed, Crewmember Exit Interview," and "Aircrew Coordination Training Validation Testbed, Evaluator and Trainer Exit Interview" are presented in Appendix E.

Summary of Validation Testbed Activities and Lessons Learned

Condensed into a four-week period from 3 August to 4 September 1993, the validation testbed conducted at Fort Campbell, Kentucky by aviators from the 101st Airborne (Air Assault) Division, adequately stressed the evaluation package.

Two utility helicopter tactical missions were used for the crew-level evaluations and to assess changes in crew mission performance. The baseline evaluation was conducted prior to the crew coordination training (pretraining condition). The second evaluation was administered after the training (post-training condition). The two missions were very similar in difficulty in terms of time stress, navigational demands, quantity and capabilities of simulated threat, etc. The objectives and tasks incorporated into the scenario were all made to present two equally difficult missions to the aircrews. Four IPs and four UTs received training to present the Aircrew Coordination Student Course and to perform the pre- and post-training evaluations. Sixteen two-person aircrews were battle-rostered for the testbed.

The first step in the testbed was for project staff trainers to instruct the participating IPs and UTs. After receiving instruction, the IPs (not UTs) rated the 16 battle-rostered participating aircrews during a full (premission, flight, and postmission) simulator session. This was the "pretraining" evaluation designed as the baseline against which performance improvements would be measured. The 16 aircrews were divided into two groups of 8 for the classroom instruction. Two teams each consisting of two IPs and two UTs were formed to team-teach the classroom instruction. The instructor teams also instructed the aircrews during the two course-related simulator training missions.

Subsequent to the training, another evaluation mission, the post-training evaluation was given to each of the 16 aircrews. The eight crews given Scenario 1 for the pretraining mission were given Scenario 2 for the post-training mission and vice versa. Again, crews were rated using the measures described above. When the evaluation missions were completed, all testbed participants were debriefed on the testbed and asked to critique the training.

Representatives from the crew coordination Working Group and the project staff recorded observations and candidate lessons learned throughout the validation testbed. Testbed participant crewmembers and trainer-evaluators contributed insights and suggestions during the testbed and in their exit interviews. All of the observations and insights surfaced during the testbed were closely examined and verified by additional sources and/or analysis of crew performance results before being considered a lesson learned.

This section provides a summary of the lessons learned during the validation testbed experience (see Table 10). The

Table 10

Summary of Testbed Evaluation Package Lessons Learned

Evaluation Topic	Lesson Learned (Source*)	Justification
Evaluation Requirements and Approach	• Unit instructor pilots and trainers understand the evaluation method and are confident using the 13 Basic Qualities to rate crew coordination (P, WG)	• Conclusion of USAAVNC Working Group based on individual and group evaluator exit interviews
	• Evaluations are objective and reliable (P, WG, PS)	• Findings published in Testbed Validation Report
	• Evaluations are consistent with current evaluation practices (P, WG)	• Consensus among all sources
	• Videotaping and playback of crew performance is critical to train and evaluate initial and continuation crew coordination training (P, WG, PS)	• Quality of evaluator and participant mission debriefings; performance and safety improvements
	• Oral examination questions are needed for comprehensive evaluation (P, PS)	• Participant critique of course completion criteria
	• Course completion evaluation mission requirements need to be clearly stated (P, WG)	• Participant critique of course completion criteria
Behavioral Measures	• Thirteen (13) Basic Qualities adequately describe all crew coordination actions (P, WG)	• Findings published in Testbed Validation Report
	• All Basic Qualities will be demonstrated in any well developed mission scenario (P, WG)	• Consensus among all sources
	• Checklist usage needs increased visibility (P, PS)	• ATM shortcoming identified by testbed evaluators
	• Rating guides and the rating scale are appropriate for initial and continuation training in any simulator or aircraft (P, WG, PS)	• Collective judgment of all sources
	• Presenting both rating factors and behavioral anchors causes confusion (P, WG, PS)	• Conclusion from individual and group exit interviews
	• Behavioral anchors produce more reliable evaluations (P, PS)	• Evaluator consensus and quality control reviews
	• Rating factors help confirm specific Basic Qualities for evaluation (P, PS)	• Consensus among trainers and evaluators
	• Behavioral anchors are the primary criteria for evaluating crew performance (P, PS)	• Evaluator exit interviews and quality control reviews

Table 10

Summary of Testbed Evaluation Package Lessons Learned (Continued)

Evaluation Topic	Lesson Learned (Source*)	Justification
ATM Tasks and Grade Slips	• Task selection is central to evaluation scenario development (P, WG) • After action review (AAR) is missing from ATM tasks (PS, WG, P) • Grade slips are understandable and easy to use (P, PS) • Expanded grading system (S+, S, S-, U) is ideal for evaluating crew performance in initial and continuation training (P, PS) • Overall mission grade is a synopsis of grade slips and evaluator worksheets (P)	• Central to link evaluations to ATMs • ATM improvement needed to evaluate crew coordination • Consistent with familiar formats • Illustrates performance levels and progression • Allows evaluators to use expert judgment
Scenario Guidance	• Simulator instructor-operator script is needed to realistically represent the tactical situation and other mission participants (P, PS)	• Realistic evaluations require consistent scenario set up and execution
Mission Performance Measures	• Measures are needed to objectively assess overall crew performance (WG)	• Demonstrates impact of crew coordination on mission
Evaluation Workbook	• Evaluator workbook is appropriate as a job aid for all phases of a mission (P) • After action review needs to be added as a scenario and evaluator worksheet mission segment (P, PS) • Evaluator worksheet format and organization is appropriate for continuation training (P,PS) • Abbreviated evaluator worksheet format reducible to grade slip size is desirable for use in actual aircraft (P)	• Maintains evaluator focus on crew coordination aspects • Improvement needed to evaluate crew coordination • Consistent framework for initial and continuation training evaluations • Consistent framework for simulator and aircraft training evaluations

* Working Group (WG), Project Staff (PS), Participants (P)

lessons learned are organized by the evaluation topics introduced in the previous section to describe how the evaluation products were developed. The table includes a short justification or reference to the rationale for each lesson learned. Discussion of the most important lessons learned and their impact on the Field Exportable Evaluation Package for continuation training amplifies the summary table.

Working Group and Project Staff

Working Group representatives attended the evaluator training, reviewed testbed emerging results, and participated in the exit interviews to acquire first-hand knowledge about the evaluation method's strengths and weaknesses. Project staff presented the evaluator training and administered the testbed activities.

Evaluation lessons learned identified by the Working Group and project staff tend to be crew coordination program-wide in scope. For example, the Working Group was particularly interested in whether or not unit evaluators could comprehend and apply the evaluation method with its thirteen Basic Qualities and behaviorially anchored rating scale. Instructor pilot-evaluators and unit trainers expressed their comfort in using the evaluation method and confidence in the objectiveness and reliability of their evaluations. Project staff debriefed testbed evaluators after every mission to provide quality control of evaluation results and collect comments on the evaluation method itself. Analysis of the data collected using the evaluation method demonstrated high levels of reliability (see Testbed Validation Report).

Testbed evaluators echoed other study findings regarding the training and evaluation benefit of videotaping crew performance. Review of videotaped missions during mision debriefings allowed evaluators to accurately critique crew coordination actions and resolve inconsistencies with crewmembers. Working Group, project staff, and testbed participants concluded that videotaping and playback of crew performance is essential to train and evaluate crew coordination initial and continuation training.

The introduction phase of the crew coordination training course informed crews that the post-training evaluation mission would be the course completion criteria. Working Group and project staff recognized the need to more clearly specify the evaluation requirements for course completion and provide evaluators with candidate oral examination questions.

Another area of interest expressed by the Working Group was the ability of the 13 Basic Qualities to address all aspects of crew coordination. Working Group and project staff assessment of participant feedback concluded that the Basic Qualities adequately describe all crew coordination actions and that all of the Basic Qualities would be demonstrated in well developed

scenarios. It was learned that including two techniques for rating crew performance initially confused the evaluators. Analysis of evaluator experience based on having used both the rating factor and behavioral anchor techniques concluded that:

1. the rating factors initially helped confirm specific Basic Qualities for evaluation until the evaluators gained experience using the behavioral anchors,

2. the behavioral anchors produced more reliable evaluation results, and

3. behavioral anchors are preferred as the primary criteria for evaluating crew performance.

The Working Group examined the role of ATM tasks and ATM-based grade slips in the evaluation method to ensure consistency with implementing the revised ATMs. Working Group and project staff concluded that the emphasis on task selection in the scenario development guidance is key to linking crew coordination evaluations with the ATMs. This same emphasis must apply to selection of commander designated crew tasks for crew coordination continuation training. It is recognized that an ATM task for after action review is needed for all aircraft. It was further concluded that the ATM grade slips, revised to evaluate crew coordination, are understandable and easily adaptable to incorporate rating crew coordination Basic Qualities.

Testbed Participants

Instructor-evaluator and crewmember testbed participants provided project staff and Working Group representatives with insights and observations throughout the testbed. Participant feedback tends to be oriented toward the details of employing the evaluation methods and products. The evaluation lessons learned shown in Table 10 and discussed here are based on analysis of participant exit interview comments (see Testbed Validation Report, Appendix D).

A primary lesson learned from participants is that the evaluation method and products are consistent with the Army's current evaluation practices. Crewmembers and evaluators viewed the evaluations as professional and objective assessments of crew rather than individual aviator performance. The rating guidelines and rating scale introduced to evaluate crew performance are appropriate for initial and continuation training in simulators and aircraft.

Evaluators experimented using both the rating factors and behavioral anchors techniques to evaluate crew performance of Basic Qualities. Analysis of their experience concluded that the rating factors are helpful at first as abbreviated descriptions of the behavioral anchors and that all of the instructor-evaluators used the behavioral anchors as their primary rating

criteria. Evaluators identified the need to emphasize the use of procedure checklists in the Basic Quality descriptions.

The modified grading system and grade slips were effectively used by unit instructor-evaluators during the testbed. The expanded grading system using S+, S, S-, and U for evaluating crew performance was well received by evaluators and crewmembers. Analysis of participant experience concluded that the expanded grading system is an effective technique to illustrate performance progression, recognize exceptional performance, and better distinguish between marginal and unsatisfactory performance. The expanded grading system is appropriate for evaluating crew performance in crew coordination initial and continuation training.

It was also learned that the simulator or aircraft must be properly configured to react as expected to the emergency procedures and other tasks selected for evaluation. Simulator set up instructions and a scripted scenario are needed for simulator operators to realistically represent the tactical situation and other participants in the mission, for example, nonrated crewmembers and other aircraft.

Project staff debriefings with evaluators after each mission disclosed that the overall mission grade is a synopsis of ATM task grade slip entries and mission performance information recorded on evaluator worksheets. Unit instructor-evaluators used the evaluator workbooks, provided as an interim evaluation package, as a job aid throughout the testbed. Analysis of their experience concluded that the evaluator workbook is applicable to all phases of a mission and that the evaluator worksheet format and organization is appropriate for continuation training. An abbreviated evaluator worksheet that is reducible to grade slip size is desirable for use in the actual aircraft. Evaluators identified the need to add after action review (AAR) as a scenario and evaluator worksheet mission segment.

These lessons learned from using the validation testbed evaluation package were incorporated into the Field Exportable Evaluation Package design and recommendations for use in evaluating crew coordination continuation training.

Description of the Field Exportable Evaluation Package

Evaluation lessons learned from the validation testbed were used to improve the evaluation process for crew coordination initial and refresher training and to develop an exportable evaluation process for crew coordination continuation training. Improvements to the evaluation process for initial and refresher training and the training presented to evaluators on how to conduct evaluations are reported in Volume II, Development of Candidate Crew Coordination Training Methods and Materials. This section describes how the testbed experience was used to develop

the Field Exportable Evaluation Package, published separately, and summarizes its contents.

Development

The evaluator's workbook developed for the validation testbed served as the interim or "trial" evaluation package and was the basis for developing the Field Exportable Evaluation Package for continuation training (see Figure 6).

Validation testbed lessons learned endorsed the evaluation method, crew coordination Basic Qualities, and behaviorally anchored ratings as consistent with the evaluation guidelines published in the ATMs. Improvements to the basic method for evaluating crew performance emphasized:

1. the nature of the training being evaluated, that is, initial and/or refresher training or continuation training, and

2. the "crawl-walk-run" level of proficiency training philosophy.

The evaluation method for initial and/or refresher training concentrated on the evaluator's instructional activities during "crawl and walk" training evaluations (see Training Methods and Materials Report). The evaluation method for crew coordination continuation training, described below, is precisely aligned with the sequence of activities for crewmember and crew flight evaluations published in Chapter 8 of the ATMs. This form of the

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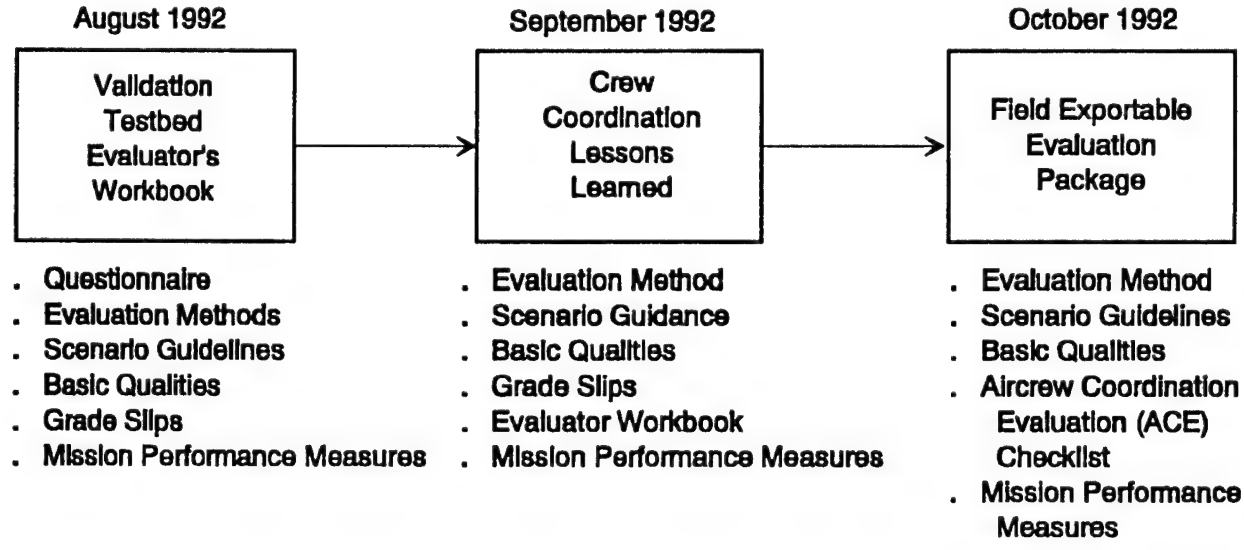

Figure 6. Development of Field Exportable Evaluation Package

evaluation method stresses the "run" level of proficiencyto be maintained by crews during continuation training. The basic evaluation method includes the use of video recording and oral examination questions to achieve objective, reliable evaluations.

Revised grade slips and evaluator worksheet lessons learned complemented the ATM requirement that the Battle-Rostered Crew Evaluation/Training Grade Slip be used to record the results of continuation training evaluations. The Aircrew Coordination Evaluation (ACE) Checklist was developed to replace the Aircrew Coordination Training Grade Slip reserved for initial and/or refresher training only. The ACE Checklist provides for a summary rating of the 13 Basic Qualities using the same behavioral anchors and rating scale as used in initial training. The evaluator worksheet was modified to reflect commander designated crew tasks. The expanded grading system and contributing Basic Quality entries were retained to provide a means for evaluating continuation training with the same precision that was used to certify completion of initial training. Evaluators are instructed to use Ace Checklist and evaluator worksheet entries as input to complete the Battle-Rostered Crew Evaluation/Training Grade Slip.

Contents

The Field Exportable Evaluation Package contains a separate section that addresses each of the evaluation topics abstracted below.

Purpose. The express purpose of the Field Exportable Evaluation Package is to distribute evaluation methods and materials approved by the USAAVNC for units to evaluate crew coordination continuation training. Developed and tested in conjunction with the Crew Coordination Exportable Training Course, these methods and materials provide the detail needed to implement the evaluation guidance published in the Aircrew Training Manuals (ATM). The package also includes suggestions on applying crew coordination evaluation results to unit operations.

Evaluation Method. The method for evaluating crew coordination is consistent with evaluation guidelines in the Army's ATMs. The materials in the evaluation package provide precisely defined measures and grading scales for the crew coordination skills in the ATM standards. The crew coordination evaluation method complements the sequence of activities for crewmember and crew flight evaluations described in Chapter 8 of the ATMs.

1. Phase 1 - Introduction. In this phase, the evaluator confirms the purpose of the evaluation (for example, to certify the crew's completion of refresher training, or to demonstrate proficiency in crew tasks) and discusses the criteria to be used

(for example, ATM task standards, and Crew Coordination Basic Qualities).

2. Phase 2 - Oral Examination. Crews must have a working knowledge and understanding of the crew coordination subject area. The evaluator selects items from the list of crew coordination sample questions and/or locally constructed questions.

3. Phase 3 - Flight Evaluation. This phase consists of a mission briefing and premission planning and rehearsal, mission execution in a flight simulator or aircraft, and a crew-level after-action review. Evaluators use scenario materials to brief the mission and to provide the information necessary for flight planning. While video recording the crew's premission planning and rehearsal, evaluators observe and rate performance of Crew Coordination Basic Qualities. During mission execution, evaluators coordinate scenario events and use evaluation materials, for example, rating guidance and scenario-specific evaluator worksheets to observe and rate the crew's performance of Crew Coordination Basic Qualities.

4. Phase 4 - Debriefing. During this phase, the evaluator video records the crew-level after-action review. The evaluator observes and rates the crew before posting ratings and grades to the grade slip. Evaluators then use their worksheets and play back selected portions of the videotapes during the crew debriefing.

Instructions for Use. This section provides users with instructions on how to apply the methods and materials in the package. Specific instructions are included in the discussion of each crew coordination evaluation item in the package. If differences exist between the evaluation guidance in TC 1-210 and/or the ATMs and the evaluation package, TC 1-210 and the ATMs take precedence. For example, the following instructions apply to the evaluation techniques and tools included in the package:

1. Grade Slips. Supplement the Battle-Rostered Crew Evaluation/Training Grade Slip (DA 7121-R) with the Aircrew Coordination Evaluation (ACE) Checklist to record Crew Coordination Basic Quality ratings.

2. Evaluator Worksheet. Develop scenario-specific worksheets to sequence crew tasks and record notes for grade slip preparation.

3. Mission Performance Measures. Select appropriate measures that relate crew coordination evaluation results to unit operations, for example, rounds or missiles on target and difference between planned and actual time of arrival.

Video Recording Guidance. The evaluation method incorporates video and/or audio recording and playback of crewmember interactions. Video and/or audio playback and review of aircrew actions has proven to be a powerful training and evaluation technique for crew coordination, making it possible to record the aircrew during all phases of a mission (that is, premission planning and rehearsal, mission execution in the simulator or aircraft, and crew-level after-action review). The types of audio-visual equipment available to aircrew coordination continuation training evaluators will determine the extent to which this evaluation opportunity is realized. The evaluation package provides a table of representative equipment needed and potential sources.

Scenario Development Guidance. This section of the package provides general and specific guidance for developing realistic tactical scenarios to accurately evaluate crew coordination in simulators and aircraft. The information in this section interprets and extends the broad guidance on developing scenarios contained in doctrine and training literature. Guidelines for scenario developers include detailed development steps, information sources, and sample scenario products.

Evaluation Techniques and Tools. The package provides a section of detailed information on the techniques and tools approved for evaluating crew coordination in continuation training. The techniques (evaluation process, mission performance measures, etc.) and tools (ACE Checklist, Evaluator Worksheet, etc.) are designed to accommodate all Army aircraft--rotary and fixed wing. This section includes descriptions and instructions for using grade slips, the ACE Checklist, effectiveness factors, rating scale and rating guidelines, Basic Qualities and behavioral anchors, and evaluator worksheets.

Unit Operations. This section of the package provides information and suggests ways to apply crew coordination evaluation results to unit training and operations. Techniques and tools are offered to communicate insights gained during the research and development phase of the Crew Coordination Program that can benefit aviation unit operations.

Recommendations for Exportable Evaluation Package Fielding, Use, and Improvement

This section provides a summary of recommendations for fielding, applying, and improving the Field Exportable Evaluation Package. It recommends actions to authorize and require units to use the evaluation package and describes ways to apply crew coordination evaluation results to unit training and operations. The section concludes by suggesting actions that the USAAVNC and/or field units could take to improve continuation training evaluations and the crew coordination training program.

Fielding Recommendations

The new ATMs do not provide sufficient detail to implement the published evaluation guidance. Unit instructor pilots and unit trainers participating in the validation testbed stated that they understood the evaluation methods and were confident that the ratings they made were objective and reliable. Recommend that:

1. The Field Exportable Evaluation Package methods and materials be approved for use by units to conduct crew coordination continuation training.

2. The Field Exportable Evaluation Package be distributed to units with instructor pilots certified as having completed the Army Crew Coordination Training Program. Suggested minimum contents for the exportable evaluation package include:

- Background on method development.
- Video recording guidance.
- Scenario development guidance.
- Evaluation tools and techniques, that is; evaluation process, grade slips, the ACE Checklist, evaluator worksheets, and suggested mission performance measures.

3. At least one flight simulator at each facility be equipped with a video recording capability to support evaluation of crew coordination performance. Consideration should be given to equipping designated aircraft that do not have a visual simulator with a similar video recording capability.

Other recommendations for fielding the Exportable Evaluation Package and recommendations for additional research to test evaluation methods and materials in conditions not analyzed to date are presented in the Testbed Report.

Applications

The Field Exportable Evaluation Package describes a method and procedures for units to apply crew coordination evaluation results to assess crew risk.

Risk Management. Risk management is a fully integrated part of mission planning and execution for peacetime situational training exercises and actual combat missions. Commanders, staff, troop leaders, and individual soldiers are responsible for the effective management of risk.

As commanders and staff apply the risk management guidance in TC 1-210, they should consider including crew coordination evaluation results in their SOPs and programs to manage risk.

Crew risk assessment is central to Army aviation's three-tier approach to risk management: individual, crew, and collective/unit training. Current guidance includes two considerations for assessing crew risk: 1) whether the crew is battle-rostered and 2) how long since the crew has flown together.

Crew coordination evaluation results provide a rich source of reliable, objective information on crew strengths and weaknesses. Detailed information contained in the crew coordination evaluation grade slips and crew performance measures is relevant and can be included in assessing crew risk. The evaluation package provides examples of the types of crew evaluation results information that could be considered in risk matrices and risk analysis techniques.

Suggested Improvements

The Field Exportable Evaluation Package describes suggested methods and procedures for improving continuation training evaluations by introducing mission performance measures and strengthening the crew coordination training program by incorporating evaluation results into crew status tracking and unit readiness reporting.

Mission Performance Measures. The validation testbed demonstrated that mission performance measures extend the evaluation of crew tasks to overall mission performance. ATMs emphasize that research has shown direct, positive effects of crew coordination on flight safety and mission performance. Used in the USAAVNC crew coordination research experiments, mission performance measures can help units relate crew coordination evaluation results to unit operations (for example, rounds or missiles on target, difference between planned and actual time of arrival).

The process for developing crew tasks described in TC 1-210, "Commander's Guide to Individual and Crew Training," includes a review of unit and collective training publications, for example, ARTEP Mission Training Plan (MTP) and Battle Drills. Analysis of the unit's MTP missions is a guide to the identification of mission performance areas and specific mission performance measures for evaluation. Study of potential mission performance areas is necessary to ensure that they can be realistically included in scenario segments and evaluated in a flight simulator or aircraft.

The evaluation package provides suggestions for developing mission performance measures, to include example measurement areas and measures.

Crew Tracking and Unit Readiness. The evaluation package suggests that units consider using continuation training evaluation results to assist in determining the status of unit

crew coordination training and unit readiness. For example, TC 1-210 requires that unit commanders maintain crew task iteration tracking sheets and crew grade slips. A Crew Training Record (DA Form 7122-R) is provided to monitor a crew's progress in completing the commander's designated tasks and required iterations, for example, day, night, and night vision device.

The ACE Checklist attached to each crew evaluation grade slip provides an additional source of information to track crew progress. Units could record and compare the rating column entries across a series of ACE Checklists to identify the crew's strengths, weaknesses, and trends with respect to Basic Qualities. This information could be used to tailor continuation training for a crew and provide focus areas for evaluators.

The status of crew proficiency could be determined by totaling the ratings for each Basic Quality across all crews and computing an average for each Basic Quality, that is, sum the rating values for Basic Quality 1 across all crews and divide by the number of crews, then repeat the process for Basic Qualities 2-13. This provides a unit-level average rating, that is, (1) Very Poor to (7) Superior for each Crew Coordination Basic Quality. This information could be used to identify a unit's crew coordination strengths and weaknesses and to assist in determining the number of days needed to fully train to standard on unit METL tasks.

Crew coordination evaluation results could provide supporting data for the commander's assessment of unit readiness. Total all Basic Quality ratings for all crews and compute a unit average rating, that is, sum all rating values for all Basic Qualities for all crews, divide by 13, and then divide by the number of crews. This provides a unit average crew coordination rating, that is, (1) Very Poor to (7) Superior. This information could be used to support the commander's aviator training readiness C-rating based on percent of RL-1 crews.

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Note: This section contains all of the publications cited in the report, as well as important related publications not cited in the report.

Appendix A

Army Aviation Crewmember Questionnaire

Appendix A

Army Aviation Crewmember Questionnaire

Instructions

The US Army Aviation Center (USAAVNC) and the US Army Research Institute (ARI) are researching the area of crew coordination in Army Aviation. The goal of this research is to improve performance and increase the margin of safety on an Army-wide basis. Previous research by other DoD services and commercial aviation into the area of crew coordination has contributed to substantial gains in both performance and safety.

Because Army Aviation is unique, much of the information discovered by the other services and the commercial world is not directly applicable to the Army Aviation environment. Consequently, the USAAVNC-ARI research program is designed to meet the specific needs of Army aviation. As a result of this approach, the following actions are now ongoing or planned: Mission simulations are being developed to stress aircrew-type tasks, enhanced aircrew coordination training is being developed, the US Army Safety Center is incorporating crew factors into the accident investigation process, Aircrew Training Manuals and the annual proficiency and readiness test program are being revised, and revisions to readiness reporting are being planned.

This Army Aviation Crewmember Questionnaire has been developed as part of the USAAVNC-ARI research program to obtain your opinion about crew operations. As an Army aviator, your participation is essential to the program's success. Your opinions are important and will be used to guide the next phase of the research program.

The questionnaire should take approximately 20 minutes to complete. The first page of the questionnaire asks you for background information -- please try to be accurate. The next three pages contain 46 statements for which there are no "right" or "wrong" answers. We are simply asking for your honest opinion to each statement. Please consider each statement carefully.

THANK YOU FOR YOUR PARTICIPATION.

IMPORTANT

The information you provide in this questionnaire is confidential and will be used for research purposes only. Your answers will neither be attributed to you personally nor become a part of any personnel or aviation record kept on you.

Army Aviation Crewmember Questionnaire

I. Background Information

(Please complete the following information regarding your personal experiences and current status.)

1. Aviation Experience:

	Lifetime Flying Experience		Experience over last 6 months	
	All Conditions	NV Devices (e.g., NVG)	All Conditions	NV Devices (e.g., NVG)
a. Primary acft hrs.	_____	_____	_____	_____
b. R/W hrs.	_____	_____	_____	_____
c. Fixed Wing hrs.	_____	_____	_____	_____

2. Primary Aircraft _____ *(Fill in aircraft designation)*
3. Current Rank _____
4. Current Unit (Co/Bn/Rgt) _____
5. Time in Current Unit (months) _____
6. Current Aviator Readiness Level (RL) 1 2 3 *(circle one number)*
7. Current Crew Readiness Level (CRL) 1 2 *(circle one number)*
8. Current primary duty assignment in unit *(check one)*:

   PC*___ PI ___ CP ___ CPG ___ CE/FE ___ AO/AFSO/TO___ OR*___

   **Note: PC includes IP, SP, IE, UT, ME, MP duty positions; OR includes gunner and flight medic.*
9. Are you flight lead qualified *(circle one)*: Yes No
10. Have you had Aircrew Coordination Training? Y or N *(circle one: if yes, answer below.)*

    Describe ACT training experiences: Course title, location of training, approximate date, # of hours of instruction, quality of course.

    a. Experience #1: _____

    _____

    b. Experience #2: _____

    _____
11. Cross-indexing Code (*Note*: Because the results of this questionnaire will be correlated with other measures, a social security number is required.)

Social Security #: _____ Today's Date _____
(day/mo/yr)

II. Opinion Survey

(Please circle the number on the agree-disagree dimension that best reflects <u>your personal attitude</u> toward each statement. There are no "right" or "wrong" answers. We are simply asking for your honest opinions.)

		Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
1.	**Crewmembers should feel obligated to mention their own psychological stress or physical problems to other crewmembers before or during a mission.**	1	2	3	4	5	6	7
2.	**Crewmembers should monitor each other for signs of stress or fatigue and should discuss the situation with the affected crewmember(s).**	1	2	3	4	5	6	7
3.	**Good communication and crew coordination are as important as technical proficiency for the safety of the flight.**	1	2	3	4	5	6	7
4.	**Crewmembers should be aware of and sensitive to the personal problems of other crewmembers.**	1	2	3	4	5	6	7
5.	**The pilot flying the aircraft should verbalize plans for procedures or maneuvers and should be sure that the information is understood and acknowledged by affected crewmembers.**	1	2	3	4	5	6	7
6.	**Even when fatigued, I perform effectively during most critical flight maneuvers.**	1	2	3	4	5	6	7
7.	**Pilots-in-command should encourage pilots and crew chiefs to question procedures and flight profile deviations during normal flight operations and in emergencies.**	1	2	3	4	5	6	7
8.	**There are no circumstances where the pilot should take the aircraft controls without being directed to do so by the pilot-in-command.**	1	2	3	4	5	6	7
9.	**A debriefing and after action review of procedures and decisions after each mission are important for developing and maintaining effective crew coordination.**	1	2	3	4	5	6	7
10.	**Crew coordination is more important under high stress conditions than it is under low stress conditions.**	1	2	3	4	5	6	7
11.	**Effective crew coordination requires crewmembers to take into account the personalities of other crewmembers.**	1	2	3	4	5	6	7

		Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
12.	**The pilot-in-command's responsibilities include coordinating inflight crew chief activities.**	1	2	3	4	5	6	7
13.	**Most crewmembers are able to leave personal problems behind when flying a mission.**	1	2	3	4	5	6	7
14.	**My decision making ability is as good in emergencies as it is in routine mission situations.**	1	2	3	4	5	6	7
15.	**The pilot-in-command is solely responsible for leadership of the crew team.**	1	2	3	4	5	6	7
16.	**Pilots should consider crew chief questions and suggestions.**	1	2	3	4	5	6	7
17.	**When joining a unit, a new crewmember should not offer suggestions or opinions unless asked.**	1	2	3	4	5	6	7
18.	**Because crew chiefs have no pilot training, they should limit their attention to their formally defined crew chief duties.**	1	2	3	4	5	6	7
19.	**Pilots-in-command who accept and implement suggestions from the crew lessen their stature and reduce their authority.**	1	2	3	4	5	6	7
20.	**Crewmembers should monitor the pilot-in-command's performance for possible mistakes and errors.**	1	2	3	4	5	6	7
21.	**The best way to correct an error is to alert the error maker so that he can correct the problem.**	1	2	3	4	5	6	7
22.	**Crewmembers' errors and mistakes during the mission, including the pilot-in-command's mistakes, should be a significant part of post flight crew discussions.**	1	2	3	4	5	6	7
23.	**The pilot-in-command should seek advice from crewmembers when updating mission plans.**	1	2	3	4	5	6	7
24.	**The pilot-in-command should use his crew to help him maintain situation awareness.**	1	2	3	4	5	6	7
25.	**The pilot-in-command is solely responsible for maintaining awareness of crew capabilities.**	1	2	3	4	5	6	7
26.	**Only when the pilot-in-command is overloaded should he pass workload to other crewmembers.**	1	2	3	4	5	6	7

		Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
27.	**Crewmembers should be aware of other crewmembers' workload.**	1	2	3	4	5	6	7
28.	**If a crewmember is having difficulties executing his responsibilities, other crewmembers should provide assistance.**	1	2	3	4	5	6	7
29.	**Highly competent pilots do not experience task overload.**	1	2	3	4	5	6	7
30.	**A crewmember should offer task help to another crewmember only if he is sure the crewmember needs it.**	1	2	3	4	5	6	7
31.	**The pilot-in-command should not get involved with the execution of responsibilities assigned to other crewmembers.**	1	2	3	4	5	6	7
32.	**Crewmember task overload usually occurs because the crewmember is not very competent.**	1	2	3	4	5	6	7
33.	**Pilots-in-command should employ the same style of leadership in all situations and with all crewmembers.**	1	2	3	4	5	6	7
34.	**Pilot-in-command instructions to other crewmembers should be general and non-specific so that each individual can practice self-management and can develop individual skills.**	1	2	3	4	5	6	7
35.	**A relaxed attitude is essential for maintaining a cooperative and harmonious cockpit.**	1	2	3	4	5	6	7
36.	**Reprimands are more effective than discussions in eliminating a crewmember's poor flying habit.**	1	2	3	4	5	6	7
37.	**Nonrated crewmembers should be actively involved in planning the mission.**	1	2	3	4	5	6	7
38.	**Understanding the commander's concept is of minor importance to mission execution.**	1	2	3	4	5	6	7
39.	**Each crewmember should watch for situations in which external events limit others' performance.**	1	2	3	4	5	6	7
40.	**Thinking through difficult segments, events, and tasks is primarily the pilot-in-command's responsibility.**	1	2	3	4	5	6	7
41.	**My knowledge of unit SOP and aircraft emergency procedures makes rehearsing familiar missions unnecessary.**	1	2	3	4	5	6	7

		Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
42.	**An essential element of premission planning is discussing crew responsibilities and required actions for abnormal events.**	1	2	3	4	5	6	7
43.	**Recent events in my personal life have little to do with my performance as a crewmember.**	1	2	3	4	5	6	7
44.	**Crewmembers should be able to anticipate requirements as the mission progresses.**	1	2	3	4	5	6	7
45.	**My individual performance is as good in degraded systems conditions as it is in a "full up" aircraft.**	1	2	3	4	5	6	7
46.	**External circumstances require crewmembers to provide situational leadership for short periods of time.**	1	2	3	4	5	6	7

Appendix B

Aircrew Coordination Rating Guidelines and Basic Qualities

Note: The Aircrew Coordination Evaluation (ACE) Checklist, developed for use in the Field Exportable Evaluation Package, is presented here as an index to the crew coordination Basic Qualities

Rating Scale

The following numeric rating scale is used to assess the level of behavior that crews exhibit for each basic quality shown on the Aircrew Coordination Evaluation (ACE) Checklist (see Figure B-1) and at the bottom of the Aircrew Coordination Training Grade Slip. Each basic quality is rated using a seven-point scale with values ranging from 1 (very poor) to 7 (superior):

Very Poor	Poor	Marginal	Accept-able	Good	Very Good	Superior
1	2	3	4	5	6	7

Rating Guidelines

Written descriptions of the types of behaviors and levels of performance are shown for rating values 1, 4, and 7. These descriptions serve as behavioral "anchors" and are designed to assist evaluators in determining how well a crew performs on each basic quality in relation to a well-defined set of behaviors. Evaluators should use the "anchors" as the standard for making ratings--avoid comparing one crew's performance with that of another crew's; rate a crew's performance in relation to the "anchors." To ensure reliable ratings, continue to refer to the anchors when making rating responses until *completely* confident and understand *fully* how to rate each basic quality.

In completing a basic quality rating, evaluators should decide whether the behaviors observed fall into the low end of the basic quality range (values 1 or 2), the middle of the range (values 3, 4, or 5), or the high end of the range (values 6 or 7). Once the general range of response is selected, use the anchors to help select the final rating value. For example, if a crew did an adequate job of pre-mission planning and rehearsal, the rating would come from the middle of the range (3, 4, or 5). After determining this, review the behavioral description (anchor) associated with value 4 to determine if crew performance resembled this description (4 value), was somewhat less than this description (3 value), or was a little better than this description (5 value). Use the end-point anchors similarly to help determine ratings that fall near the ends of the scale.

Army aviation crews that have little or no training in aircrew coordination techniques will score most frequently in the lower half of the scale. Most other crews, however, will fall into the middle area of the scale. Keep in mind that although Army aviators have well developed basic flying skills, as a group, their aircrew coordination skills will be much like the rest of the population. A few crews will have strong coordination and communication skills, a few will have weak skills, and a significant number will have moderate skills.

AIRCREW COORDINATION EVALUATION (ACE) CHECKLIST

For use of this form, see Aircrew Coordination Exportable Evaluation Package for Army Aviation.

PC_____ Date _____

PI _____

NCM _____

_____

NO	CREW COORDINATION BASIC QUALITIES	RATING
1	Establish and maintain flight team leadership and crew climate (Crew Climate)	
2	Premission planning and rehearsal accomplished (Plan Rehearse)	
3	Application of appropriate decision making techniques (Decision Tech)	
4	Prioritize actions and distribute workload (Workload)	
5	Management of unexpected events (Unexp Events)	
6	Statements and directives clear, timely, relevant, complete, and verified (Info Xfer)	
7	Maintenance of mission situational awareness (Sit Aware)	
8	Decisions and actions communicated and acknowledged (Comm/Ack)	
9	Supporting information and actions sought from crew (Info Sought)	
10	Crewmember actions mutually cross-monitored (Cross Monitor)	
11	Supporting information and actions offered by crew (Info Offered)	
12	Advocacy and assertion practiced (Advoc/Assert)	
13	Crew-level after-action reviews accomplished (AAR)	

Evaluator's Signature:

Notes:
Consult the behavioral anchored rating guidance. Enter a summary rating (1, 2 ... 7) in the rating block for each Basic Quality. Refer to the rating scale below.

RATING SCALE

Very Poor 1	Poor 2	Marginal 3	Acceptable 4	Good 5	Very Good 6	Superior 7

AIRCREW COORDINATION EVALUATION (ACE) CHECKLIST

Figure B-1. Behavioral anchored ratings.

BASIC QUALITY 1. Establish and maintain flight team leadership and crew climate (Crew Climate)

Explanation:

This rating assesses the quality of relationships among the crew and the overall climate of the flight deck. Aircrews are teams with a designated leader and clear lines of authority and responsibility. The pilot-in-command sets the tone of the crew and maintains the working environment. Effective leaders use their authority but do not operate without the participation of other crewmembers. When crewmembers disagree on a course of action, rate the crew's effectiveness in resolving the disagreement. Note: Traditional leadership centralizes leadership in the leader with followers fully dependent on the leader. Functional leadership assigns leadership and followership roles as the situation evolves. Flight team leadership recognizes the impact of leadership style on the working environment. Regardless of leadership style, the pilot-in-command retains final decision and direction authority.

Superior Rating (7)

The crewmembers have very good interpersonal relationships. They respect each others' skills and appear to enjoy being with each other. The climate is very open; crewmembers freely talk and ask questions. Crewmembers encourage the individual with the most information about the situation-at-hand to participate. There is a genuine concern for good working relationships. No degrading comments or negative voice tones are used in interactions. Disagreements are perceived as a normal part of crew interactions, and the crew directly confronts the issues over which the disagreement began. Arguments or disagreements focus on behaviors or solutions rather than on personalities. Each crewmember carefully listens to others' comments. Senior crewmembers accept challenges from junior crewmembers. Alternative solutions are explored. The solution produced is a "win-win" situation in which all crewmembers' opinions are considered. The crewmembers have no hard feelings at the conclusion of the incident.

Acceptable Rating (4)

The crewmembers have sound interpersonal relationships and seem to respect each others' skills. The climate is an open one, and crewmembers are free to talk and ask mission questions. Regardless of rank or duty position, the individual with the most information about the situation-at-hand is allowed to participate. When disagreements arise, the crew directly

confronts the issues over which the disagreements began. The primary focus is on behaviors or solutions, and no personal attacks are made in the heat of discussion. The solution is generally seen as reasonable. Problem resolution ends on a positive note with very little hostility or grumbling among crewmembers. Mutual respect is clearly intact.

Very Poor Rating (1)

Crew interactions are often awkward and uncomfortable. The crewmembers do not appear to like or respect each other. Crewmembers may be curt and impolite to each other. Requirements for assistance are made as commands rather than as requests for support. When disagreements arise, the crew fails to directly confront the issues. Personal attacks may arise. Senior crewmembers are resistant to recommendations from junior crewmembers. Crewmembers do not explore the range of possible solutions. They may shout and argue without finding a solution. One or more crewmembers may retreat and say nothing at all. A "win-lose" situation develops in which one crewmember is shown to be right and the other to be wrong. The crewmembers show little respect to one another except for deferring to formal rank.

BASIC QUALITY 2. Pre-mission planning and rehearsal accomplished (Plan Rehearsal)

Explanation:

This rating assesses the pre-mission planning and rehearsal activities that the crew performs upon receiving a mission order. Time available determines whether pre-mission planning and rehearsal is completed prior to the flight or in the cockpit. During this period crews--

•Clarify the mission order and the commander's intent
•Assign actions, duties, and mission responsibilities
•Collect information (intelligence, communications, weather, flight planning) and develop the plan
•Conduct crew briefing to review and discuss the plan
•Identify potential problem areas and courses of action
•Assess risks
•Visualize and rehearse the mission

Although the pilot-in-command is responsible for leading this activity, evaluate the extent and manner in which the entire crew participates. Also, consider the time constraints on the crew. If there is insufficient time to conduct comprehensive planning and rehearsal, evaluate the crew on their planning and rehearsal of

the most critical segments of the mission. That is, either prior to the flight or in the cockpit, did the crew address the most important issues given the time available? Note: The relationship among crew members should be observed during this period but the crew climate evaluation should be made on rating basic quality 1, Flight Team Leadership and Crew Climate.

Examples:

•UH-60 Task 2078 and AH-64 Task 1033, Perform terrain flight mission planning: The crew will analyze the mission in terms of METT-T and plan the flight as directed by the PC. The crew will rehearse important aspects of the mission.

•UH-60 and AH-64 Task 1000, Conduct crew mission briefing: Aircrew collectively visualizes and rehearses expected and unexpected events from takeoff to tie-down; all factors of the flight; and actions, duties, and responsibilities of each crewmember.

•AH-64 and UH-60 Task 1068, Perform or describe emergency procedures: PC will include in the crew briefing the general approach to all emergency procedures requiring immediate action.

Superior Rating (7)

The entire crew discusses a detailed description of the mission and the commander's intent. All actions, duties, and mission responsibilities are partitioned and clearly assigned to specific individuals. The crew acquires new and updated information and uses it to develop the mission plan from the aircrew mission briefing. Questions and discussion about the mission, commander's intent, and specific responsibilities are encouraged. Potential problems are noted and discussed in detail. Courses of action and individual responsibilities are established in the event that potential problems actually occur. All crewmembers speak out and acknowledge an understanding of the operational risks in the mission plan. The pilot-in-command leads the crew in mentally rehearsing the entire mission by visualizing and talking the crew through potential problems and contingencies. Crewmembers acknowledge understanding their assigned responsibilities and cues for actions. The tone of the interaction is friendly and professional.

Acceptable Rating (4)

A brief description of the mission is provided to the entire crew. The mission responsibilities are partitioned and assigned to specific individuals. Actions are taken to update current information that adds to the aircrew mission briefing and helps develop the mission plan. One or more crewmembers make comments during the course of developing the mission plan. Potential mission problems are only briefly discussed. There is adequate

preparation for contingencies. Crewmembers briefly discuss the operational risks in the mission plan. Mental rehearsal is initiated by the pilot-in-command or another crewmember who talks through potential problems or contingencies for one or more mission segments. Some discussion takes place to clarify responsibilities in the event of unexpected problems or contingencies. The tone of the interaction is generally friendly and businesslike.

Very Poor Rating (1)

The pilot-in-command briefs the mission with little or no attendant explanation. There is little or no discussion of responsibilities or their assignments to specific crewmembers. The pilot-in-command develops the mission plan from the aircrew mission briefing and current information. Crewmembers tend not to ask questions about the mission. If asked, questions tend to be cut off, only briefly addressed, or ignored by the other crew-members. Little or no mention is given to potential problems or complications. No crewmember says anything about operational risks or weaknesses in the plan. Any suggestion to talk through a potential problem or mentally rehearse responsibilities is rejected as unnecessary. The tone of the interaction is business-like, abrupt, and impersonal.

BASIC QUALITY 3. Application of appropriate deci-making techniques (Decision Tech)

Explanation:

This rating evaluates the manner and quality of the crew's problem solving and decision making performance throughout the planning and execution of the mission. Factors to consider in making this evaluation include (1) information available to the crewmembers, (2) time urgency of the decision, (3) objectivity reflected in the decision process, and (4) level of involvement and information exchange among the crewmembers. The time critical demands of tactical flying require many decisions to be made on an automatic, pattern-recognition basis with only a minimum level of information exchange. However, when adequate time and information are available, crewmembers are expected to engage in a more deliberate and interactive style of decision making. The evaluation of crew decision making performance should ask the following questions: (1) Did the crew use all of the available information? (2) Was the level of information exchange among crewmembers appropriate for the time available? (3) Was the type of decision process (deliberate versus automatic) appropriate for the time available?

Examples:

•UH-60 and AH-64 Task 2044, Perform actions on contact: Crew will discuss options for developing the situation, then choose a course of action that supports the intent of the unit commander's directives.

•AH-64 and UH-60 Task 2083, Negotiate wire obstacles: Crew will discuss the characteristics of the wires . . . to determine the method of crossing.

Superior Rating (7)

Crew decision making consistently reflects proper attention to available information throughout mission planning and execution. The level of crew participation and deliberate analysis of options is appropriate for the decision time available. Resulting decisions are timely and appropriate given the time urgency and level of information available in each situation. Crewmembers do not exhibit any of the known hazardous thought patterns (e.g., anti-authority, impulsivity, machoism, invulnerability, resignation, get-home-itis, overconfidence in other aviator) and appear motivated to seek the most mission effective and safe decision in each situation. The crew decides and implements a course of action before the situation jeopardizes crew performance or mission accomplishment.

Acceptable Rating (4)

Crew decisions occasionally reflect inadequate sharing or use of available information. On limited occasions, crewmembers dwell excessively on some issues while neglecting more time urgent requirements. Most decisions are timely, but crew performance begins to show signs of self-induced stress. Most decisions are appropriate for the situation, with the crew occasionally overlooking one or more factors or options. Crewmembers occasionally fail to recognize or exploit opportunities for additional planning or rehearsal, substituting instead *ad hoc* strategies or plans. Crewmembers do not exhibit any of the known hazardous thought patterns. The situation may worsen, without seriously degrading mission accomplishment, before the crew decides and implements a course of action.

Very Poor Rating (1)

Crew performance (both pre-flight and in-flight) reflects an inflexible style of decision making (either deliberate or automatic) regardless of time urgency. Crewmembers may engage in excessive deliberation, overlook the relative time urgency of competing decision requirements, or fall victim to inappropriate mind sets. As a result, decisions frequently lack timeliness, ignore important factors, or appear out of context. Information

exchange and crewmember interaction is minimal, with the result that critical input is ignored or not sought. Crewmembers may display one or more of the known hazardous thought patterns (e.g., machoism, anti-authority, get-home-itis). The crew may be unable to decide or implement a course of action before a situation becomes critical.

BASIC QUALITY 4. Prioritize actions and distribute workload (Workload)

Explanation:

This is a rating of the effectiveness of time and work management. Rate the extent to which the crew as a team avoids being distracted from essential activities, distributes workload, and avoids individual crewmember overload.

Examples:

•AH-64 and UH-60 Task 1080, Perform procedures for two-way radio failure: P* will remain focused outside the aircraft or inside the cockpit on the instruments, as appropriate. He will not participate in troubleshooting the malfunction.

•UH-60 Task 2079 and AH-64 Task 1064, Perform terrain flight navigation: P will focus his attention primarily inside the cockpit; however, as workload permits, he will assist in clearing the aircraft and provide adequate warning of traffic and obstacles.

Superior Rating (7)

Virtually all distractions are avoided. Each crewmember understands precisely what information is relevant to the mission and what information is simply a distraction. If a crewmember becomes mildly distracted, other crewmembers remind him to focus on the mission task. Non-critical duties are prioritized and delayed until low workload periods or post-flight periods. Crewmembers are aware of workload build ups on others and readjust workload by assuming emerging, unassigned tasks appropriate for their duty station. Overloads do not occur. The crew's planning horizon is always "ahead of the aircraft."

Acceptable Rating (4)

Most distractions are avoided. The crew performs well in deciding what information and activities are essential to the

mission. Most non-essential information is discarded or ignored. Non-critical duties are prioritized and delayed until low workload periods or post-flight periods. Crewmembers are aware of individual crewmember workloads during each phase of the mission. When an individual crewmember appears to be overloaded, other crewmembers take on part of the workload. The crew is always "in sync with the aircraft."

Very Poor Rating (1)

The crew is easily distracted. The crew is unable or unwilling to decide what is important and relevant to the immediate mission. There is little prioritizing of duties or actions. Time and energy may be wasted on low priority tasks. Risks to crew safety may occur as the crew focuses on minor tasks while critical tasks requiring immediate attention go unattended, (e.g., setting a radio frequency when attention should be focused on clearing an obstacle.). Neither the overloaded party nor other crewmembers takes voluntary actions to eliminate an overload condition. The crew makes little or no effort to redistribute task responsibilities as mission changes occur and new tasks arise. Individual crewmembers experience workload overloads. The crew's planning horizon is sometimes "behind the aircraft."

BASIC QUALITY 5. Management of unexpected events (Unexp Events)

Explanation:

This rating evaluates the crew's performance under unusual circumstances that may involve high levels of stress. This judgement includes the integration of technical and managerial aspects of contending with the situation. Note: Enter the abnormal or emergency situation in the Aircrew Coordination Training Grade Slip (some emergency procedure ATM tasks are preprinted) and grade it the same as any task.

Examples:

•AH-64 and UH-60 Task 2008, Perform evasive maneuvers: The most important consideration in an emergency is aircraft control--first assess aircraft controllability, check systems indicators, take evasive action.

•UH-60 Task 1068, Perform or describe emergency procedures: CE will keep communications to a minimum to allow the P* or P to attempt communications outside the aircraft.

Superior Rating (7)

The crew remains calm during the situation. Each crewmember seeks to understand the problem and provides the pilot-in-command with essential information. Each crewmember immediately takes on particular workload responsibilities based on prior discussions and rehearsal of potential problems and contingencies. The crew effectively communicates its actions and results to others and provides feedback to ensure complete coordination of efforts. Each crewmember handles his own responsibilities and seeks to support the crewmember with the greatest workload. The crew rapidly imposes the maximum amount of control possible over the situation given the available time and internal and external resources. A high level of situation awareness is maintained throughout the event.

Acceptable Rating (4)

The crew responds to the problem and the pilot-in-command's requests for information but does not overreact. The pilot-in-command's requests for information are met by feedback from the crew. The crew takes actions to reduce the pilot-in-command's work overload and provides information even if it is not specifically requested. The pilot and crew make good use of available resources. The crew is intense but not flustered by the situation. Adequate situation awareness is maintained throughout the event.

Very Poor Rating (1)

The crew becomes disorganized and flustered. The pilot-in-command's requests for information elicit inadequate responses. Crewmembers may focus on the wrong issues, thus delaying correct diagnosis of the problem. The crew focuses on only one solution to an event, does not consider other plausible alternatives, or chooses an inappropriate solution. Lack of coordinated actions adds to the confusion. The pilot and crewmembers make poor use of available resources to resolve the problem. Situation awareness appears to decay during the situation.

BASIC QUALITY 6. Statements and directives clear, timely, relevant, complete, and verified (Info Xfer)

Explanation:

Rate the completeness, timeliness, and quality of information transfer. Carefully consider the crew's feedback techniques to

verify information transfer. In particular, evaluate the quality of instructions and statements associated with navigation activities, obstacle clearing activities, and instrument readouts.

Examples:

•AH-64 Task 1015, Perform ground taxi: The P will announce "Blocking" to acknowledge the P*'s announcement "Braking".

•UH-60 Task 2079, Perform terrain flight navigation: The P* will acknowledge commands issued by the P for heading and airspeed changes.

Superior Rating (7)

Crewmembers communicate frequently. Both senders and receivers use standard terminology for nearly all communications. Senders almost always provide clear, concise information. Receivers acknowledge nearly all messages in sufficient detail so that the sender can verify that the receiver understands the message. Receivers ask for clarification when they do not understand. Senders pursue feedback when no response is forthcoming. Whenever a workload shift or task responsibility transfer occurs, the change is communicated and acknowledged by the crew. All navigation, obstacle clearing, and "inside" or "outside" the cockpit information is stated, acknowledged, and updated.

Acceptable Rating (4)

Crewmembers communicate about the mission as required. Standard terminology is usually used. Receivers acknowledge most messages. Receivers ask questions when they do not understand. Senders usually pursue feedback when no response is forthcoming. Crewmembers are appraised of changes to responsibilities during the flight. "Inside" and "outside" the cockpit duties are specified and communicated to others.

Very Poor Rating (1)

Crewmembers may fail to make statements regarding critical information. Non-standard terminology is used or standard terminology is used inappropriately. Sender messages may be inappropriately delayed or irregular and may be confusing. Receivers usually do not verbally acknowledge the receipt of messages. Receivers do not ask questions. Senders do not pursue feedback when no response is forthcoming. Changes in responsibilities during the mission are often not communicated and may result in confusion over who has a task responsibility. Navigation instructions and obstacle location information may be incomplete or confusing. At times, "inside" or "outside" the cockpit responsibilities are not clearly communicated.

BASIC QUALITY 7. Maintenance of mission situation awareness (Sit Aware)

Explanation:

This rating assesses the extent to which crewmembers keep each other informed on the status of the aircraft and mission accomplishment. This information reporting helps maintain a high level of situation awareness among the flight crew. Information reported includes:

•Aircraft position and orientation
•Equipment status
•Personnel status
•Environment and battlefield conditions
•Changes to mission objectives

Crew-wide situation awareness is an essential element of safe flying and effective crew performance.

Examples:

•UH-60 Task 2009, Perform multi-aircraft operations: P and CE will provide adequate warning to avoid traffic or obstacles.

•AH-64 Task 2008, Perform evasive maneuvers: When engaged by the enemy, crew will announce the nature and direction of the threat.

Superior Rating (7)

Crewmembers routinely provide each other with updates on the status of the elements of situation awareness and the status of the mission. Crewmembers anticipate the situation awareness needs of others and request needed information when it is not forthcoming. Crewmembers are aware of each others' mental and physical states and are not hesitant to alert others to personal problems that could undermine effective performance. Personnel status is voluntarily shared without fear of sanctions. All changes in the elements of situation awareness are verbalized and acknowledged. Crewmembers alert other crewmembers to the presence of obstacles.

Acceptable Rating (4)

Crewmembers usually provide updates on the status of most of the elements of situation awareness and the status of the mission. Changes to the situation awareness elements are verbalized. Obvious changes in personnel status are noted and acknowledged without fear of sanctions.

Very Poor Rating (1)

Crewmembers do not routinely provide updates on the status of the aircraft or the status of the mission. Generally, updates are provided only on request; they are not made voluntarily. Personnel problems such as fatigue or lack of attention are not mentioned.

BASIC QUALITY 8. Decisions and actions communicated and acknowledged (Comm/ Ack)

Explanation:

Rate the extent to which decisions and actions are actually made and announced to the crewmembers after input is solicited from them. Crewmembers should respond verbally or with the appropriate adjustment to their behaviors, actions, or control inputs to clearly indicate that they understand when a decision has been made and what it is. Failure to do so may confuse crews and lead to uncoordinated operation. Note: Due to time constraints in certain situations, there is often little or no time for crews to make inputs to a decision. In such cases, raters should focus on the extent to which decisions are acknowledged verbally or through coordinated, pre-planned action.

Examples:

•UH-60 Task 2086, Perform masking and unmasking: P* will announce his intent to unmask. The P and CE will acknowledge that they are prepared to execute the maneuver.

•AH-64 Task 1038, Perform terrain flight approach: P* will announce intention of a go-around . . . whether approach will terminate to a hover or to the ground. P will acknowledge use of manual stabilator or any intent to deviate from the approach.

Superior Rating (7)

The pilot-in-command states decisions and actions and, time permitting, explains the reasons and intent. Crewmembers acknowledge the decisions with a clear verbal response and ask questions to clarify any confusion. The pilot-in-command answers all questions in a positive, straight-forward manner. Crewmembers keep the pilot-in-command informed of the results of their activities and changing responsibilities--especially visual area of responsibility or task focus. The crew clearly acknowledges results of actions, or changes, and then states its intended adjustments based on the information provided. If crewmembers do not acknowledge or adjust, the pilot-in-command

requests acknowledgement. Crewmembers are particularly attentive to the communication of workload responsibilities. When assuming control of the aircraft or making control inputs, notification is always given and acknowledgement received.

Acceptable Rating (4)

The pilot-in-command states decisions and actions along with, time permitting, a brief explanation of the reasons and informs the crew of the adjustments they are expected to make. The crew acknowledges its awareness of the decisions and directions. Crewmembers may ask questions to clarify confusion. The pilot answers questions clearly and quickly and the crew adjusts to the new situation. When assuming control of the aircraft or making control inputs, notification is given and acknowledged.

Very Poor Rating (1)

Decisions and actions of a crewmember are often not passed on to the crew. The pilot-in-command takes unilateral action and does not explain or inform the crew of his intended purpose. The crew is often not aware that a decision has been made. The crew infrequently asks questions for clarification. The pilot-in-command may not acknowledge or respond to questions. The crew may not know how to react to changed circumstances. Crewmembers are often unsure what responsibilities have been assigned to them. Crewmembers may take uncoordinated actions without stating intentions or results. Two pilots may attempt to simultaneously take control of the aircraft when flight control authority is unclear.

BASIC QUALITY 9. Supporting information and actions sought from crew (Info Sought)

Explanation:

This is a rating of the extent to which crewmembers, usually the pilot-in-command, seek support information and support actions from the crew. Evaluate the degree to which crewmembers raise questions during the flight regarding plans, revisions to plans, actions to be taken, and the status of key mission information. Note: The extent to which crewmembers maintain situational awareness and contribute to decision making should be observed here but evaluated on basic qualities 7 and 4 respectively.

Examples:

•UH-60 Task 1032, Perform slope operations: P* will request assistance in setting the brakes.

•AH-64 Task 2044, Perform actions on contact: The crew will discuss options for developing the situation.

Superior Rating (7)

During the flight, crewmembers raise questions on plans or changes to plans and actions. Virtually all of these inquiries surface information that contributes to the mission decision making process. When the pilot-in-command realizes that a decision must be made during the flight, for which there is no clear standardized answer, he immediately alerts the crew to the situation and seeks suggestions on possible solutions and important information to consider. The pilot-in-command is open to all suggestions. Crewmembers respond to these inquiries with sound, task-focused discussions and clear answers that are provided in a timely manner. Crewmembers' inquiries are never ignored. All crewmembers encourage such questioning. When the pilot-in-command asks for assistance with actions he clearly states what assistance is required. He provides quick, clear feedback if the crewmember response is not what he expects. He asks for assistance before becoming overloaded.

Acceptable Rating (4)

During the flight, crewmembers occasionally raise questions on plans or actions when they are unclear on decisions being made. Most of these inquiries provide information that is relevant to the mission decision making process. The pilot alerts the crew to the need for decision input. Crewmembers usually respond to these inquiries with brief but reasonable answers. Crewmembers' inquiries are encouraged by other crewmembers most of the time. The pilot-in-command listens to suggestions without interruption or criticism. He asks for clarification as necessary. He only asks for assistance when he becomes overloaded.

Very Poor Rating (1)

During the flight, crewmembers almost never raise questions about plans, actions, or changes to plans. The pilot-in-command makes mission decisions without seeking inputs from other crewmembers. The pilot-in-command does not alert the crew that a decision is required or is being made. Decision making and planning are done by one individual with little or no discussion--an observer will have difficulty noting this quality for "very poor" crews since it is hard to detect individual decision making. The few inquiries that are made are generally ignored or abruptly answered. Crewmembers may discourage others from asking questions by the tone of voice they use or by failing to respond.

The pilot-in-command may not ask for crew assistance with tasks even when he is overloaded to the point of nearly failing to properly execute tasks.

BASIC QUALITY 10. Crewmember actions mutually cross monitored (Cross Monitor)

Explanation:

This rating captures the extent to which a crew uses cross monitoring as a mechanism to avoid errors and improve future performance. Crewmembers are able to catch each other's errors. Such redundancy is particularly important when crews are fatigued or overly focused on critical task elements, and thus more prone to make errors. Included in this rating is the crew's use of aircraft technical manual checklists to perform required procedure checks and procedures (i.e., engine-start, run-up, before-takeoff, before- and after-landing, shutdown checks; HIT and emergency procedures). Note: This quality does not imply that task responsibilities are not clearly defined. It asks the question "To what extent do crewmembers help an individual assigned primary responsibility for a task or action by reviewing the quality of that individual's task execution and alerting him to any mistake noted?"

Examples:

•AH-64 Task 1094, Identify major US or allied equipment and major threat equipment: P* or P will announce the type and direction of the equipment detected. The other crewmember will confirm the type and direction of the equipment.

•UH-60 task 1023, Perform fuel management procedures: PC will confirm the results of the fuel check.

Superior Rating (7)

Each crewmember is concerned that all tasks are properly executed and checks both his tasks and those of others. When mistakes are noted, the crewmember making the error is quickly informed in a concise manner without excessive formality. The mistake maker accepts this review and feedback as a normal part of crew operations.

Acceptable Rating (4)

Crewmembers often check each other's task performance for errors. Mistake makers are informed and make the needed corrections. Only

occasionally are mistake makers annoyed at being checked and corrected.

Very Poor Rating (1)

Crewmembers seldom, if ever, check each other's task execution. Crewmembers are insulted if they are corrected by another crewmember.

BASIC QUALITY 11. Supporting information and actions offered by crew (Info Offered)

Explanation:

This is a rating of the extent to which crewmembers anticipate and offer support information and support actions to the decision maker, usually the pilot-in-command, when it becomes apparent that a decision must be made or an action taken.

Examples:

•UH-60 Task 2016, Perform external load operations: All crewmembers will assist in clearing the aircraft and will provide adequate warning of obstacles, unusual drift, or altitude changes.

•UH-60 and AH-64 Task 1081, Perform nonprecision approach: P will call out the approach procedure to the P*.

Superior Rating (7)

The crew recognizes that a decision must be made and offers suggestions and information to the pilot-in-command. The crew checks for responses that indicate understanding. The information is repeated, as necessary, to ensure that the pilot-in-command understands the input. Pilot-in-command responses can be verbal or non-verbal actions. The crew seeks information and provides it to support decisions and actions. The crew frequently offers task execution support. The support offered always reflects the pilot-in-command's task needs. Crews are quick to offer support during particularly difficult tasks such as obstacle clearing.

Acceptable Rating (4)

The crew recognizes that a decision or action must be made and offers suggestions and information to the pilot-in-command. The crew sometimes offers task execution support. Crewmembers usually offer obstacle clearing support.

Very Poor Rating (1)

The crew does not offer suggestions and inputs to support decision making or actions. Moreover, it often appears that the crew does not even realize that a decision is being made. The crew generally does not offer its services to support task execution for other crewmembers. Crewmembers may fail to offer obstacle clearing support.

BASIC QUALITY 12. Advocacy and assertion practiced (Advoc/Assert)

Explanation:

This rating evaluates the extent to which crewmembers advocate a course of action they consider best, even when it may differ with the one being followed or proposed. Note: Except under extreme emergency conditions where time is absolutely

critical, it is usually in the crew's best interest to hear the full range of viewpoints available.

Examples:

•UH-60 and AH-64 Task 2083, Negotiate wire obstacles: Crew will discuss the characteristics of the wires . . . to determine the method of crossing.

•AH-64 Task 2044, Perform actions on contact: Crew will discuss options for developing the situation.

Superior Rating (7)

Crewmembers state to the rest of the crew a course of action that they consider best. They clearly explain their reasons for believing this to be the best course. Other crewmembers listen to the argument before presenting any criticism or proposing alternate courses. Discussions focus on the strengths and weaknesses of the proposed course of action, not on the personality of the crewmember who proposed the action.

Crewmembers call the crew's attention to changes in the situation and provide information that is essential to the proper execution of another crewmember's task. Crewmembers pursue feedback to ensure that their views are heard and understood. Other crewmembers expect such open comments and view them as positive contributions to mission performance.

Acceptable Rating (4)

Crewmembers state their support for a course of action or suggest improvements to other proposed actions. Each crewmember makes an effort to explain his position and convince others to concur with him on the course of action to be taken. Other crewmembers may interrupt with their views and alternatives. Crewmembers usually speak out when they recognize a departure from the mission plan or standard procedures or when they have a piece of information that is important to another's task execution. Crewmembers seek assurances that presented information has been received. Other crewmembers view such comments as constructive and not as a challenge to authority.

Very Poor Rating (1)

The crew almost never suggests a course of action. Crewmembers attempting to propose a course of action may be cut-off before they can propose the action or explain the rationale for that action. Crewmembers proposing courses of action may receive personal attacks. The crew raises few, if any concerns. Crewmembers may even fail to intervene when risks such as obstacles or poor visibility arise.

BASIC QUALITY 13. Crew-level after-action reviews accomplished (AAR)

Explanation:

This rating evaluates the extent to which the crew reviews and critiques its decisions and actions during or following a mission segment, during low workload periods, or during the post flight debrief. Evaluate the crew on their discussion of strengths and weaknesses (for example, what was done wrong, what might be done better, how improvements can be made, and what was done very well) in flight skills and aircrew coordination.

Superior Rating (7)

The entire crew reviews and critiques its decisions and actions throughout the mission, including the pre-mission planning and rehearsal process. Crewmembers review factors considered in making their decisions, identify additional options or factors,

including ways to "buy time," that should have been considered, and discuss different methods of weighing information in the decision process. All discussions focus on behaviors and information and carefully avoid any "finger-pointing" tones. The focus is clearly on education and understanding to improve individual and collective performance.

Acceptable Rating (4)

Senior crewmember(s) review and critique the crew's decisions and actions during problematic segments of the mission. They determine the major mistakes in the crew's actions or decisions and identify remedial actions or alternative options for future missions. Although the critiques are intended to educate the crew and to improve their performance during future missions, they may include some accountability for unsatisfactory performance.

Very Poor Rating (1)

The crew either fails to review and critique its mission performance or if a critique is performed, it is punitive or accusatory. That is, the critique is conducted primarily to assign blame for unsatisfactory performance. Little effort is made to identify lessons learned or to suggest constructive ways to improve future performance.

Aircrew Coordination Basic Qualities and Rating Factors

Basic Quality 1 Establish and maintain flight team leadership and crew climate

Issue 1-1 Leadership Style

a. What type of cockpit atmosphere did the PC establish?

- ☐ PC actively established an open climate where crew members freely talked and asked questions
- ☐ PC permitted an open climate with some discussion and questioning among crew members
- ☐ PC created a restrictive climate by means of an authoritarian management style

b. Did the PC acknowledge each individual to be a part of the crew?

- ☐ PC considered each crew member to be an important contributor to mission success
- ☐ PC acknowledged each crew member as part of the team
- ☐ Some crew members felt ignored by the PC and were reluctant to speak up

Issue 1-2 Professional Respect

a. Did crew members show professional respect to each other?

- ☐ Each crew member was valued for their expertise and judgement
- ☐ Crew members showed an acceptable level of professional courtesy to one another
- ☐ Crew members openly or indirectly belittled one another

b. Did rank or experience differences influence the respect shown to junior crew members?

- ☐ Junior crew member performance was actively promoted through positive encouragement and professional respect
- ☐ Junior crew members were shown professional respect regardless of rank or flight hour experience
- ☐ Junior crew members were shown little or no professional respect because of their rank or flight hour experience

Issue 1-3 Resolution of Disagreements

a. Were differences of opinion appropriately surfaced between crew members?

- ☐ Alternative viewpoints were considered a normal and occasional part of crew interaction
- ☐ Some alternative viewpoints were tolerated and did not lead to obvious disruption of teamwork
- ☐ Disagreements existed among the crew members, but were rarely surfaced for resolution

d. How were conflicts handled between crew members?

- ☐ Disagreements were handled in a professional manner without involving personal attacks or defensive posturing
- ☐ Disagreements did not involve obvious attacks of character or defensive posturing
- ☐ Conflicts involved personal attacks and resulted in a disruption of teamwork

Issue 1-4 Crew Member Attitudes

a. Did the PC play an active role in managing crew attitudes?

- ☐ PC actively monitored the attitudes of crew members and offered feedback when necessary
- ☐ PC took steps to correct obvious displays of improper or hazardous attitudes
- ☐ PC exhibited a hazardous attitude, or tolerated such an attitude in other crew members

b. Did the crew members give proper consideration to safety?

- ☐ Each crew member actively displayed a proper concern for balancing safety with mission accomplishment
- ☐ Crew members did not display any obvious disregard for safety during the mission
- ☐ Displays of hazardous attitudes by one or more crew members potentially jeopardized flight safety

Basic Quality 2 Premission planning and rehearsal accomplished

Issue 2-1 Premission Flight Planning

a. Did the PC assign critical actions, duties, and mission responsibilities?

- ☐ PC actively insured that all actions, duties, and mission responsibilities were partitioned and clearly assigned to specific crew members
- ☐ No obvious assignments were overlooked regarding critical actions, duties, or mission responsibilities
- ☐ One or more critical actions, duties, or mission responsibilities were overlooked during the premission planning process

b. How involved was each crew member in the planning process?

- ☐ Each crew member was actively involved in the mission planning process so as to insure a common understanding of mission intent and operational sequence
- ☐ All crew members had a general understanding of mission intent and operational sequence; each crew member participated at least minimally in the planning process
- ☐ One or more crew members had an inadequate or incorrect understanding of mission intent or operational sequence due to lack of involvement in planning process

c. Did the crew prioritize its planning activities within the available time?

- ☐ Planning activities were prioritized to insure that critical items were addressed within the available planning time
- ☐ Planning activities were generally prioritized within the available time, with no major component of the mission overlooked
- ☐ Little attention was given to prioritizing planning activities within the available planning time; some components of the mission were neglected

Issue 2-2 Premission Rehearsal

a. Were alternative courses of action identified and discussed?

- ◘ Alternative courses of action were identified in anticipation of potential changes in METT-T factors; crew was fully prepared to implement contingencies as necessary
- ◘ Some attention was given to identifying alternative courses of action; crew reacted to changes in METT-T factors, but some additional planning was required
- ◘ Little or no attention was paid to identifying alternative courses of action; changes in METT-T factors required substantial replanning by crew members

b. Did the crew members mentally rehearse critical flight segments?

- ◘ Crew members mentally rehearsed the entire mission by visualizing and discussing potential problems, contingencies, and responsibilities
- ◘ Crew members gave some attention to discussing potential problems, contingencies, and responsibilities; however, they stopped short of mentally rehearsing critical flight segments or sequences
- ◘ Crew failed to discuss or rehearse critical flight segments and sequences; they began the mission with very limited understanding or agreement concerning potential problems, contingencies, or responsibilities

Issue 2-3 In-Flight Replanning and Rehearsal

a. Did the crew take advantage of low workload periods to rehearse up-coming flight segments?

- ◘ PC actively insured that crew members took advantage of low workload periods during mission to rehearse upcoming flight segments
- ◘ Crew members engaged in some in-flight rehearsal of up-coming flight segments; no major coordination problems arose that could be attributed to a failure to rehearse
- ◘ Little or no attention was given to in-flight rehearsal of up-coming flight segments; some coordination problems were attributed to a failure to rehearse

b. Did the crew anticipate required adjustments, keeping ahead of critical time horizons?

- ◘ Crew members continuously reviewed remaining flight segments to identify required adjustments; planning consistently kept ahead of critical time horizons
- ◘ Crew members occasionally reviewed remaining flight segments to identify required adjustments; planning generally kept ahead of critical time horizons
- ◘ Through inattention, crew members frequently fell behind in anticipating required adjustments as the mission progressed; in-flight planning consistently appeared rushed

Basic Quality 3 Selection of appropriate decision making techniques

Issue 3-1 High Time Stressed Decisions

a. Did the crew avoid excessive deliberation when inconsistent with time urgency of decision?

- ◘ Crew members consistently relied on a pattern-recognition decision process to produce timely responses; deliberation is minimized, consistent with available decision time
- ◘ Crew members generally avoided excessive deliberation when it was inconsistent with the time urgency of the decision; decisions met minimal time requirements
- ◘ Crew members displayed an inflexible decision style, engaging in excessive deliberation; delayed decisions frequently compounded the difficulties faced by the aircrew

b. Did the crew members focus on only the most critical factors influencing the decision?

- Crew members consistently displayed an ability to focus on only the most critical factors influencing their choice of response
- Crew members generally addressed the most critical factors, while occasionally being distracted by secondary issues
- Crew members lost focus and became distracted by secondary factors

c. Did the crew members efficiently prioritize their specific information needs?

- Crew members efficiently prioritized their specific information needs, consistent with available decision time
- Crew members generally requested only information that was obtainable within the available decision time
- Crew members delayed critical decisions by seeking information that was unattainable within the available decision time

Issue 3-2 Moderate/Low Time Stressed Decisions

a. Did crew members adequately deliberate each decision, consistent with available time?

- Crew members consistently relied on an analytical decision process to produce high quality decisions; deliberation was encouraged, consistent with available decision time
- Crew members generally engaged in some deliberation, avoiding decisions that appeared to reflect impulsive or hazardous attitudes
- Crew members displayed an inflexible decision style, frequently responding in an impulsive manner with little or no deliberation; impulsive decisions frequently compounded the difficulties faced by the crew

b. Did crew members address each important factor influencing the decision?

- Crew members consistently considered all important factors influencing their choice of action, seeking the most unbiased decision possible
- Crew members generally addressed the important factors influencing their choice of action, avoiding obvious decision biases or gaps in logic
- Crew members overlooked one or more important factors influencing their choice of action; one or more types of decision biases were evident in their thinking

c. Did crew members seek out all available information?

- Crew members consistently sought out all available information relative to the factors being considered
- Crew members generally sought out the most important information relative to the factors being considered
- Crew members failed to seek out one or more important pieces of available information relative to the factors being considered

Basic Quality 4 Prioritize actions and distribute workload

Issue 4-1 Task Prioritization

a. Did the crew consistently prioritize competing mission tasks?

- ◘ Crew members were consistently able to identify and prioritize competing mission tasks; flight safety and other high-priority tasks were never ignored; low-priority tasks were appropriately delayed until they do not compete with more critical tasks
- ◘ Crew members were generally able to maintain a focus on flight safety and other high-priority mission tasks; task prioritization was acceptable, but could be improved
- ◘ Low-priority tasks were occasionally attended to at the expense of flight safety or other higher priority tasks; significant compromises in flight safety or mission effectiveness occurred

b. Were the crew members distracted by non-essential events or radio traffic?

- ◘ Crew members consistently avoided non-essential distractions; distractions had no impact on task performance
- ◘ Crew members generally avoided non-essential distractions; some distractions arose, but had no impact on flight safety or mission effectiveness
- ◘ Crew members were easily distracted by non-essential events and radio traffic; distractions resulted in significant compromises in flight safety or mission effectiveness

Issue 4-2 Workload Distribution

a. Did the PC appropriate manage the distribution of mission tasks to prevent overloads?

- ◘ PC actively managed distribution of mission tasks to prevent any crew member from being task overloaded, especially during critical phases of flight
- ◘ Distribution of workload was not optimal, but no serious incidents of task overload occurred with any one crew member
- ◘ Maldistribution of workload occurred; task overload of one or more crew members significantly related to an issue of flight safety or mission effectiveness

b. Did the crew members cooperatively adjust individual task responsibilities to prevent overload?

- ◘ Crew members were consistently aware of workload buildup on others and reacted quickly to adjust distribution of task responsibilities
- ◘ Crew members maintained some awareness of workload buildup on others; workload was adjusted before serious compromise to flight safety or mission effectiveness occurs
- ◘ Crew members were generally unaware of workload buildup on others; little or no attempt was made to adjust the distribution of task responsibilities before significant compromises to flight safety or mission effectiveness occurred

Basic Quality 5 Management of unexpected events

Issue 5-1 Crew Preparation and Composure

a. Did the crew reflect a consistent understanding of emergency procedures?

- ◘ Crew actions reflected extensive rehearsal of emergency procedures in prior training and premission planning and rehearsal

- ◻ Crew actions reflected consistent understanding of emergency procedures; responses were adequately standardized to avoid significant conflicts or misunderstandings
- ◻ Crew actions reflected misunderstanding of emergency procedures; little or no evidence of prior rehearsal during training or premission planning was evident

b. Did the crew react in a coordinated manner with minimal verbal direction?

- ◻ Crew member actions and information exchange were highly coordinated with minimal verbal direction from the PC
- ◻ Crew member actions and information exchange proceeded smoothly, although moderate direction from the PC was necessary
- ◻ Crew actions and information exchange required extensive direction from the PC in order to avoid significant conflicts or misunderstandings

c. Did the crew display a calm, professional composure?

- ◻ Crew members responded in a composed, professional manner
- ◻ Crew composure was tense, but not flustered
- ◻ Crew composure was disorganized and flustered

Issue 5-2 Resource Management

a. Did crew members adjust workload and task priorities with minimal verbal direction?

- ◻ Each crew member appropriately adjusted individual workload and task priorities with minimal verbal direction from the PC
- ◻ Each crew member appropriately adjusted individual workload and task priorities, although moderate direction from the PC was necessary
- ◻ One or more crew members failed to appropriately adjust workload during the course of the unexpected event, resulting in a significant compromise to flight safety or mission effectiveness

b. Was each crew member effectively utilized in responding to the unexpected event?

- ◻ Each crew member was effectively utilized in responding to the emergency; workload was efficiently distributed
- ◻ Each crew member was utilized in responding to the emergency, with no major maldistributions of workload
- ◻ One or more crew members was inappropriately utilized or underutilized, resulting in a significant compromise to flight safety or mission effectiveness; other crew members experienced task overload

Basic Quality 6 Statements and directives are clear, timely, relevant, complete, and verified

Issue 6-1 Adequacy and timeliness

a. Were all required or recommended call-outs accomplished by crew members?

- ◻ All required or recommended call-outs (as defined in the ATM) were made by crew members on a consistent basis
- ◻ Required or recommended call-outs were generally made by crew members, with no major omissions that significantly compromised flight safety or mission effectiveness
- ◻ Required or recommended call-outs were frequently ignored by crew members; significant compromises in flight safety or mission effectiveness occurred

b. Were statements and directives provided in a timely manner?

- ◻ Statements and directives were consistently offered in a timely manner
- ◻ Statements and directives were generally offered in a timely manner, with no delays that significantly compromised flight safety or mission effectiveness
- ◻ Statements and directives were frequently late, creating additional workload pressure for other crew members; significant compromises to flight safety or mission effectiveness occurred

Issue 6-2 Clarity

a. Did the crew use standard terminology?

- ◻ Crew members consistently used standard terminology for all communications
- ◻ Crew members generally used standard terminology; no significant misunderstandings occurred
- ◻ Crew members failed to use standard terminology, resulting in misunderstandings

b. Were statements and directives clear and concise?

- ◻ Statements and directives were clear and concise
- ◻ Statements and directives communicated clear messages; ambiguity was generally avoided
- ◻ Statements and directives contained ambiguous references or irrelevant information

Issue 6-3 Acknowledgement

a. Did crew members seek feedback when misunderstandings were apparent?

- ◻ Crew members actively sought feedback when there was no acknowledgement from another crew member
- ◻ Crew members sought feedback when it appeared that another crew member has misunderstood a statement or directive
- ◻ Crew members disregarded the need for feedback; misunderstandings occurred between crew members

b. Did crew members acknowledge statements and directives from others?

- ◻ Crew members consistently acknowledged all messages to indicate their understanding of intent; crew members consistently requested clarification when necessary
- ◻ Crew members generally acknowledged messages and requested clarification when necessary; no significant misunderstandings occurred
- ◻ Crew members frequently failed to acknowledge messages; misunderstandings occurred

Basic Quality 7 Maintenance of mission situational awareness

Issue 7-1 Awareness Level of Crew

a. Did crew members keep each other aware of critical mission factors, obstacles, or conditions?

- ◻ Crew members routinely updated each other on critical mission factors, obstacles, or conditions; significant changes were highlighted and acknowledged
- ◻ Crew members occasionally updated each other on critical mission factors, obstacles, or conditions; no significant compromises to flight safety or mission effectiveness occurred

- Crew members disregarded need to keep each other informed of critical mission factors, obstacles, or conditions; significant compromises to flight safety or mission effectiveness occurred as a result

b. Did crew members take responsibility for scanning entire flight environment, consistent with their primary duties?

- Crew members took personal responsibility for scanning the entire flight environment, consistent with performing their primary cockpit duties
- Crew members took personal responsibility for notifying other crew members of significant changes, even when they occurred within someone else's area of scanning responsibility
- Crew members confined their attention exclusively to their assigned area of scanning responsibility

Issue 7-2 Awareness of Factors Inhibiting Attention

a. Were crew members aware of the factors that can degrade situational awareness?

- Crew members actively discussed conditions and situations that could compromise situational awareness during the mission (e.g., stress, boredom, fatigue, anger)
- Crew members adjusted scanning and reporting patterns in accordance with the changing demands of the mission
- Crew members appeared unaware of factors that could compromise situational awareness; stress, boredom, fatigue, and/or anger were seen to affect crew member scanning

Basic Quality 8 Decisions and actions communicated and acknowledged

Issue 8-1 Communication of Decisions and Actions

a. Were decisions and actions announced in timely manner, with appropriate rationale?

- Crew members announced decisions and actions, providing rationale and intentions as time permits; verbal communications were clear and timely
- Crew members verbally announced decisions and actions; instances of significant confusion and surprise were avoided
- Crew members failed to announce decisions and actions; decisions and actions were communicated only by ambiguous body signals or utterances; confusion or surprise existed among crew members regarding actions or decisions taken

b. Did crew members accomplish transfer of controls in a positive manner?

- Crew members verbally coordinated transfer of controls or control inputs before initiating action; transfer of controls occurred smoothly
- Crew members verbally coordinated transfer of controls or control inputs before initiating action; transfer of controls occurred without significant compromise to flight safety
- Crew members made unannounced control inputs; significant compromise to flight safety occurred

Issue 8-2 Clarification and Acknowledgement

a. Did crew members acknowledge announced decisions or actions, noting impact on other crew tasks and responsibilities?

- ◻ Crew members consistently acknowledged announced decisions or actions, providing appropriate feedback regarding the impact on other crew tasks and responsibilities
- ◻ Crew members generally acknowledged announced decisions or actions; instances of significant confusion were avoided
- ◻ Crew members frequently failed to acknowledge announced decisions or actions; confusion arose among the crew members

b. Did crew members request clarification of decisions and actions, if not understood?

- ◻ Crew members promptly requested clarification of decisions or actions, as appropriate
- ◻ Crew members requested clarification of decisions or actions if significant confusion arose
- ◻ Crew members ignored need to clarify actions or decisions, resulting in significant instances of surprise and confusion; compromises to flight safety or mission effectiveness occurred

Basic Quality 9 Supporting information and actions sought from crew

Issue 9-1 Solicitation of Crew Input

a. Did the PC solicit input from other crew members regarding issues affecting flight safety or mission effectiveness?

- ◻ Crew members were encouraged by PC to actively raise issues or offer information affecting flight safety or mission effectiveness
- ◻ PC occasionally permitted crew members to raise issues affecting flight safety or mission effectiveness; no significant compromises to flight safety or mission effectiveness occurred
- ◻ PC ignored crew input or gave the impression that such inputs were unwelcome; significant compromises to flight safety or mission effectiveness arose when crew inputs were ignored or stifled by PC

b. Did the crew members alert others to impending decisions and actions?

- ◻ Crew members alerted others to impending decisions and actions; supporting information was actively solicited from other crew members
- ◻ Crew members occasionally solicited information from others regarding impending decisions and actions; no significant compromises to flight safety or mission effectiveness occurred
- ◻ Crew members did not keep each other informed of impending decisions and actions; compromises to flight safety or mission effectiveness arose when crew members waited for others to volunteer significant information

Issue 9-2 Solicitation of Crew Assistance

a. Did crew members request assistance from others to avoid becoming overloaded?

- ◻ Crew members consistently requested assistance from others before they became overloaded or diverted their attention from a critical task
- ◻ Crew members occasionally requested assistance from others when they became overloaded; no significant compromises to flight safety or mission effectiveness arose from one or more crew members being unnecessarily task overloaded

- Crew members failed to request assistance from others after becoming task overloaded; significant compromises to flight safety or mission effectiveness occurred as a result

Basic Quality 10 Crew member actions mutually cross-monitored

Issue 10-1 Scanning for Crew Error

a. Did crew members acknowledge that human error is a common occurrence?

- Crew members acknowledged that crew error is a common occurrence, requiring active involvement of all crew members in detecting and breaking the error
- Crew members understood that human errors can occur during the mission, occasionally requiring the monitoring and intervention by all crew members
- Crew members believed or acted as if human error is a rare occurrence

b. Did crew members take responsibility for scanning for errors that might affect flight safety or mission effectiveness?

- When errors were noted, the crew member committing the error was quickly informed and/or assisted in a professional manner
- Crew members assumed some responsibility for monitoring the performance of others; no significant compromises to flight safety or mission effectiveness arose from neglect of cross monitoring
- Crew members assumed only responsibility for monitoring their own performance; significant incidents of crew error remained undetected by others until flight safety or mission effectiveness was significantly compromised

c. Did crew members act quickly and constructively to assist others in correcting errors?

- Crew members were constantly alert for crew errors, assuming responsibility for monitoring their own performance and that of others for errors affecting flight safety or mission effectiveness
- When errors were noted, the crew member committing the error was informed and/or assisted; however, some improvement is possible in the timeliness or manner of monitoring
- When errors were noted, the crew used the opportunity to insult or berate the crew member committing the error

Issue 10-2 Two-Challenge Rule

a. Was the two-challenge rule discussed prior to mission execution?

- The two-challenge rule was thoroughly discussed by crew members prior to execution of mission
- The two-challenge rule was acknowledged by crew members prior to mission execution
- Crew members ignored the two-challenge rule, leaving its implementation ambiguously defined

b. Was the two-challenge rule implemented effectively, if required?

- The two-challenge rule was effectively implemented when required, with minimal compromise to flight safety
- The two-challenge rule was implemented when required, but resulted in some confusion or tension between crew members

- Crew members failed to implement the two-challenge rule when required, resulting in significant compromise of flight safety

Basic Quality 11 Supporting information and actions offered by crew

Issue 11-1 Anticipation and Offering of Required Informationa.

a. Did crew members anticipate the need to provide information and warnings to the PC or pilot on the controls?

- Crew members consistently anticipated the need to provide information or warnings to the pilot on the controls during critical phases of flight
- Crew members provided information or warnings to the pilot on the controls when requested; no significant compromises to flight safety or mission effectiveness arose due to failure to offer critical information or warnings
- Crew members failed to provide information or warnings requested by PC or pilot on the controls, or provided information and warnings only reluctantly; significant compromises to flight safety or mission effectiveness occurred as a result

b. Were information and warnings provided in a timely manner?

- Required information and warnings were consistently provided in a timely manner
- Required information and warnings were generally provided in a timely manner; no significant compromises to flight safety or mission effectiveness arose due to lack of timeliness of supporting information or warnings
- Required information or warnings, when offered, were late; significant compromises to flight safety or mission effectiveness occurred as a result

Issue 11-2 Anticipation and Offering of Required Assistance

a. Did crew members anticipate the need to provide task assistance to the PC or pilot on the controls?

- Crew members consistently anticipated the need to provide task assistance to PC or pilot on the controls during critical phases of flight
- Crew members provided task assistance to PC or pilot on the controls when requested; no significant compromises to flight safety or mission effectiveness arose due to failure to offer assistance
- Crew members failed to provide task assistance requested by PC or pilot on the controls, or provided assistance only reluctantly; significant compromises to flight safety or mission effectiveness occurred as a result

b. Was the assistance provided in a timely manner?

- Required task assistance was consistently provided in a timely manner
- Required task assistance was generally provided in a timely manner; no significant compromises to flight safety or mission effectiveness arose due to lack of timeliness of supporting assistance
- Required cockpit task assistance, when offered, was late; significant compromises to flight safety or mission effectiveness occurred as a result

Basic Quality 12 Advocacy and assertiveness practiced

Issue 12-1 Advocacy

a. Did crew members justify their recommended plans and courses of action with appropriate rationale?

- Time permitting, crew members consistently provided rationale for their recommended plans and courses of action; a professional atmosphere was maintained
- When misunderstanding was apparent, crew members provided rationale for their recommended plans and courses of action; some level of objectivity was maintained
- Crew members frequently justified their recommendations on rank or experience level, rather than logic; personality conflicts resulted from this behavior

b. Did crew members request feedback to insure others have correctly understood them?

- Crew members consistently requested feedback to insure that others had correctly understood their statements or rationale
- Crew members requested feedback when it became obvious that others had misunderstood their statements or rationale
- Crew members gave little concern to insuring that others had correctly understood their statements or rationale; misunderstandings were permitted to continue

c. Did crew members each exhibit willingness to accept input from others?

- Time permitting, crew members practiced good listening habits, allowing others to state their rationale before reacting to recommended plans or courses of action
- Time permitting, crew members generally allowed others to explain their recommendations before reacting
- Crew members displayed a closed mind with regard to accepting recommendations from others; decisions and actions were overly influenced by a crew member who possessed a dominant personality

Issue 12-2 Rank or Experience Intimidation

a. Did the PC encourage junior crew members to speak up during mission?

- PC actively promoted objectivity by encouraging junior crew members to speak up regardless of rank or experience level
- PC tolerated junior crew members to speak up regardless of rank or experience level
- PC used rank or experience factors to impose authoritarian control over other crew members

b. Were junior crew members reluctant to voice opinions that conflicted with more senior crew members?

- Junior crew members did not hesitate to speak up when they disagreed with others; junior crew members understood that more experienced aviators can occasionally commit errors or lose situational awareness
- Junior crew members voiced disagreements when asked; junior crew members spoke up when they observed obvious errors being committed by more experienced aviators
- Crew members were generally reluctant to challenge a senior or more experienced aviator, even when they knew themselves to be correct; crew members generally assumed that others knew what they were doing, regardless of the facts

c. Did each crew member display a sense of responsibility for adhering to flight regulations, operating procedures, and safety standards?

- ◘ Every crew member displayed a sense of responsibility for adhering to flight regulations, operating procedures, and safety standards
- ◘ Crew members spoke up when they believed that flight regulations, operating procedures, or safety standards were being violated
- ◘ Crew members denied personal responsibility for flight safety, allowing others to violate known flight regulations, operating procedures, or safety standards because of their rank and experience level

Basic Quality 13 Crew-level after action reviews accomplished

Issue 13-1 Critique and Improvement of Crew Performance

a. Did the crew critique major decisions and actions to identify areas of improvement?

- ◘ Crew critiqued major decisions and actions, identifying options and factors that should have been discussed, and outlining ways of improving crew performance in future missions
- ◘ Crew reviewed major decisions and actions, focusing on obvious errors, and identifying ways of avoiding those errors in future missions
- ◘ Crew avoided any discussion of major decisions and actions; obvious errors were ignored with little or no concern about improving crew performance in future missions

b. Was the after action critique conducted in a professional manner, with emphasis on education and improvement of crew performance?

- ◘ Critique of crew decisions and actions was conducted in a professional manner; finger-pointing was avoided, with emphasis on education and improvement of crew performance
- ◘ Critique of crew decisions and actions avoided personality conflicts or other attitudes that would detract from the discovery of improved procedures
- ◘ After action reviews consisted of finger pointing; little or no collaborative spirit was exhibited; the crew appears likely to repeat poor performance

Appendix C

Grade Slips

MANEUVER/PROCEDURE GRADE SLIP FOR UH-60 RCM

For use of this form, see Aircrew Coordination Exportable Training Package and TC 1-212

PC _____ Date _____

PI _____

Instructor or evaluator will sign in the first unused block.

NO	MANEUVER/PROCEDURE	GR	NO	MANEUVER/PROCEDURE	GR
1	CREW MISSION BRIEFING		27	EMERGENCY EGRESS	
2	VFR PLANNING		28	EMERGENCY PROCEDURES	
3	IFR FLIGHT PLANNING		29	HAND AND ARM SIGNALS	
4	DD FORM 365-4		30	FUEL SAMPLE	
5	DA FORM 5701-R		31	PASSENGER BRIEFING	
6	PREFLIGHT INSPECTION		32	INSTRUMENT TAKEOFF	
7	BEFORE-STARTING ENGINE THROUGH AIRCRAFT SHUTDOWN		33	RADIO NAVIGATION	
8	ALSE OPERATION		34	HOLDING PROCEDURES	
9	GROUND TAXI		35	UNUSUAL ATTITUDE RECOVERY	
10	HOVER POWER CHECK		36	RADIO COMMUNICATION PROCEDURES	
11	HOVERING FLIGHT		37	PROCEDURE FOR TWO-WAY RADIO FAILURE	
12	VMC TAKEOFF		38	NONPRECISION APPROACH	
13	TRAFFIC PATTERN FLIGHT		39	PRECISION APPROACH	
14	FUEL MANAGEMENT PROCEDURES		40	INADVERTENT IMC/VHIRP	
15	PILOTAGE AND DEAD RECKONING		41	COMMAND INSTRUMENT SYSTEM OPERATIONS	
16	ELECTRONIC-AIDED NAVIGATION		42	A/C SURVIVABILITY EQUIPMENT	
17	VMC APPROACH		43	MARK XII IFF SYSTEM	
18	ROLL-ON LANDING		44	CONFINED AREA OPERATIONS	
19	SLOPE OPERATIONS		45	PINNACLE OR RIDGELINE OPERATION	
20	AIRCRAFT REFUELING		46	FM RADIO HOMING	
21	POSTFLIGHT INSPECTION		47	EVASIVE MANEUVERS	
22	SIMULATED ENGINE FAILURE AT ALT		48	MULTIAIRCRAFT OPERATIONS	
23	SIMULATED ENGINE FAILURE AT		49	RAPPELLING OPERATIONS	
24	DEGRADED AFCS		50	INTERNAL RESCUE-HOIST OPERATIONS	
25	ECU LOCKOUT OPERATIONS		51	PARADROP OPERATIONS	
26	STABILATOR MALFUNCTION PROC		52	STABILITY OPERATIONS	

AIRCREW COORDINATION BASIC QUALITIES

1. CREW CLI-MATE	2. PLAN RE-HEARSE	3. DECI-SION TECH	4. WORK LOAD	5. UNEXP EVENTS	6. INFO XFER	7. SIT AWARE	8. COMM ACK	9. INFO SOUGHT	10. CROSS MON-ITOR	11. INFO OF-FERED	12. ADVOC/ ASSERT	13. AAR

AIRCREW COORDINATION TRAINING GRADE SLIP

MANEUVER/PROCEDURE GRADE SLIP FOR UH-60 RCM					
NO	MANEUVER/PROCEDURE	GR	NO	MANEUVER/PROCEDURE	GR
53	EXTERNAL LOAD OPERATIONS		79		
54	INTERNAL LOAD OPERATIONS		80		
55	AERIAL RADIO RELAY		81		
56	ACTIONS ON CONTACT		82		
◇57	TERRAIN FLIGHT MISSION PLANNING		83		
◇58	TERRAIN FLIGHT NAVIGATION		84		
◇59	TERRAIN FLIGHT		85		
60	WIRE OBSTACLES		86		
61	MASKING AND UNMASKING		87		
62	TERRAIN FLIGHT DECELERATION		88		
63	MAJOR US/ALLIED AND THREAT EQUIPMENT IDENTIFICATION		89		
64	TACTICAL COMMUNICATION PROCEDURES AND ECCM		90		
65	TACTICAL REPORT		91		
66	QUICK FIX MISSION		92		
67	FLAT TURN/VCALIBRATED FLIGHT		93		
68	ORAL EVALUATION		94		
69			95		
70			96		
71			97		
72			98		
73					
74					
75					
76					
77					
78					

NOTES:

◇ NVD MANEUVER
□ INSTRUMENT MANEUVER
○ STANDARDIZATION MANEUVER

ENTER S+, S, S-, OR U IN GRADE BLOCK. IF GRADE IS S- OR U DUE TO AIRCREW COORDINATION INCLUDE UP TO TWO BASIC QUALITY NUMBERS.

S- 2,5

AIRCREW COORDINATION BASIC QUALITIES												
1. CREW CLI-MATE	2. PLAN RE-HEARSE	3. DECI-SION TECH	4. WORK LOAD	5. UNEXP EVENTS	6. INFO XFER	7. SIT AWARE	8. COMM ACK	9 INFO SOUGHT	10. CROSS MON-ITOR	11. INFO OF-FERED	12. ADVOC/ ASSERT	13. AAR
GRADE												

PAGE 2, AIRCREW COORDINATION TRAINING GRADE SLIP

BATTLE-ROSTERED CREW EVALUATION/TRAINING GRADE SLIP
For use of this form, see Aircraft ATM; the proponent agency is TRADOC

BATTLE-ROSTERED CREW EXAMINEES/ TRAINEES	NAME PC:	RANK
	PI:	
	NONRATED CREW MEMBERS DUTY SYMBOL NAME	RANK
	UNIT:	
EVALUATOR/ INSTRUCTOR	NAME	RANK
	UNIT:	

CREW DATA

TOTAL BATTLE-ROSTERED CREW HOURS	DATE DESIGNATED A BATTLE-ROSTERED CREW:
PURPOSE: EVALUATION/TRAINING	
TIME TODAY:	CUMULATIVE TIME:

TYPE AIRCRAFT: _____

CREW TASK 1 _____ D/N/NVD	CREW TASK 6 _____ D/N/NVD
CREW TASK 2 _____ D/N/NVD	CREW TASK 7 _____ D/N/NVD
CREW TASK 3 _____ D/N/NVD	CREW TASK 8 _____ D/N/NVD
CREW TASK 4 _____ D/N/NVD	CREW TASK 9 _____ D/N/NVD
CREW TASK 5 _____ D/N/NVD	CREW TASK 10 _____ D/N/NVD

DAY	NIGHT	WX	SIMULATOR	NVG	NVS

EVALUATOR/INSTRUCTOR RECOMMENDATIONS

- ☐ (ISSUE) (VALIDATE) CREW QUALIFICATIONS
- ☐ (SUSPEND) (REVOKE) CREW QUALIFICATIONS
- ☐ REQUIRES ADDITIONAL (FLIGHT) (ACADEMIC) (SIMULATION DEVICE) TRAINING
- ☐ SEE BACK FOR COMMENTS

I HAVE DEBRIEFED THE EXAMINEES/TRAINEES AND INFORMED THEM OF THEIR STATUS.
EVALUATOR'S/INSTRUCTOR'S SIGNATURE: _____

WE HAVE BEEN DEBRIEFED BY THE EVALUATOR/INSTRUCTOR AND UNDERSTAND OUR CURRENT STATUS.

PC'S SIGNATURE: _____

PI'S SIGNATURE: _____

NONRATED CREW MEMBER'S SIGNATURES: _____

_____

OVERALL GRADE FOR THIS FLIGHT IS: S U NA DATE:_____

DA FORM 7121-R, MAR 92

COMMENTS

PAGE 2, DA FORM 7121-R, MAR 92

Appendix D

Mission Performance Measures

Appendix D

Mission Performance Measures

Terrain Flight Navigation-- Measured during segments 3 & 4 of the mission, depending on the scenario being flown.

What to Measure	How to Collect	Measurement Parameters
Number (N) of deviations from the corridor due to misorientation	FS printout, page 25, "Cross country map" (12 x 12 K or 24 x 24 K) with ground track trace; verified by video tape review	Sum (N)
Distance of deviation outside of corridor due to misorientation	FS printout, page 25, "Cross country map" (12 x 12 K or 24 x 24 K) with ground track trace; verified by video tape review	Sum (N) <500m Sum (N) >500m <1500m Sum (N) >1500m
Deviation (seconds) from required time of arrival at landing zone	Live observation/time on tape	Actual time compared to time designated in OPORD/FRAG
Number (N) of mission (route) segments completed	Live observation; FS printout	Sum (N)
Time (sec) to fly each mission segment	Live observation/time on tape	Elapsed time from PZ to LZ and return to PZ

Threat avoidance/evasion -- Scenario will include encounters with different enemy anti-aircraft systems. Different aural warnings in the cockpit warn of the mode of the threat weapon system: search, track, or missile. The three modes represent increasing levels of threat to the crew.

What to Measure	How to Collect	Measurement Parameters
Threat avoidance-number of activations (N) of track or missile aural warnings	Live observation	Sum (N)
Threat evasion-duration (sec) of track or missile aural warnings	Live observation	Elapsed time from beginning to cessation of track or missile aural warning
Number of track or missile aural warnings (N^2) exceeding 10 sec	Live observation	Sum (N^2)
Outcome of threat encounter	Live observation; video tape review	Broke lock, took hits, crashed, or misoriented

Aircraft emergencies -- Two aircraft malfunctions will occur during the mission. One major malfunction will require immediate crew action, whereas the other malfunction will be less severe and result in a slow, gradual change in the status of an aircraft system.

What to Measure	How to Collect	Measurement Parameters
Diagnosis of major emergency	Live observation; *Evaluator worksheet*	Correct diagnosis of emergency? (Yes/no)
Proper adherence to emergency procedures	Live observation; *Evaluator worksheet*	Number of steps accomplished versus number required
Eventual outcome	Live observation; *Evaluator worksheet*	Normal, hard, or crash landing
Time to detect minor malfunction	Live observation/time on tape; *Evaluator worksheet*	Elapsed time (sec) to discover malfunction

Unexpected event -- The unexpected event (inadvertent IMC) will lead to the instrument recovery, an NDB approach.

What to Measure	How to Collect	Measurement Parameters
Proper adherence to recovery procedures	Live observation; *Evaluator worksheet*	Number of VHIRP steps accomplished versus the number required
Eventual outcome	Live observation	Successful transition from VMC to IMC? (Yes/no)

Instrument recovery -- Crews will perform an NDB approach for recovery. The approach will be initiated following entry into inadvertent IMC. Measurements will be taken for both the planning and execution portions of the approach.

Approach planning measurements --

What to Measure	How to Collect	Measurement Parameters
Crew planning, discussion, and rehearsal of essential elements of the approach prior to executing the approach	Live observation	Both crewmembers review, discuss, and rehearse the approach (Value = 3) One crewmember reviews the approach, briefs the other prior to executing the approach, then talks him through it (Value = 2) One crewmember reviews the approach and talks the other through it (Value = 1) One crewmember reviews and executes the approach with no assistance from the other (Value = 0)

Approach execution measurements --

What to Measure	How to Collect	Measurement Parameters
Courses and headings flown during the recovery	FS printout, page 32, "Approach map" (12 x 12 K) with ground track trace; *Evaluator worksheet*	Number of deviations exceeding +/- 5 degrees
Altitudes during the recovery	Live observation; *Evaluator worksheet*	Number of deviations exceeding +/- 100 feet
Timing of the inbound leg	Live observation; *Evaluator worksheet*	Did crew properly time the inbound leg of the approach? (Yes/no)
Eventual outcome	Live observation	Following transition from IMC to VMC, was aircraft in position to safely land? (Yes/no)
Descent to minimum altitude	Live observation; FS printout; video tape review	Did crew descend below MDA at correct time? (Yes/No)

Mission threatening crew error -- There may be cases when crew error leads to an unanticipated aircraft crash, probable aircraft damage, or other disruptive events. These instances will be evaluated on a case by case basis to determine their effect on mission performance.

What to Measure	How to Collect	Measurement Parameters
Degree of adverse effect on the mission caused by unanticipated crew error	Video tape review	No occurrence of mission threatening crew error (Value = 4) Crew error results in no aircraft damage and mission fully complete with precise timing and accuracy (Value = 3) Crew error results in minor aircraft damage and/or minor deviation of mission completion within time and accuracy (Value = 2) Crew error results in temporary loss of aircraft and/or crew and mission marginally complete due to recoverable time or accuracy failures (Value = 1) Crew error would likely result in minor damage to aircraft and/or crew and/or mission is incomplete due to grass time or accuracy failures (Value = 0)
Number (N) of crews completing mission(s)	Live observation; FS printout; video tape review	Sum (N)

Appendix E

Exit Interviews

Appendix E-1

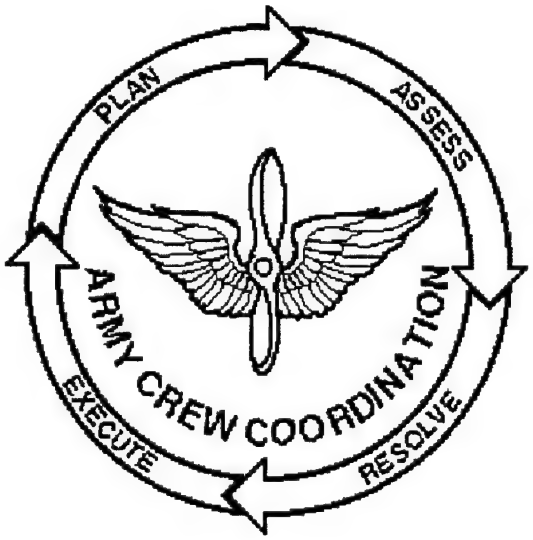
Aircrew Coordination Training Validation Testbed
Evaluator and Trainer Exit Interview

I. Introduction

This form is to be used as general guidance in structuring the debrief for the Evaluator and Trainer participants in the aircrew coordination validation testbed, August 1992. Questions are meant to be suggestive and should not restrict your answers. Some of the questions may overlap with others or seem repetitive, but we need to make sure that all the issues are covered. The order of the questions and answers is unimportant. You may skip a question if you answered it on a previous question. The entire set of questions will be discussed with the Evaluators and Trainers. The debrief forum will involve both individual and group interviews according to the published schedule.

Important

- Participants must bring the Aircrew Coordination Exportable Training Package materials to the debriefing.
- It is suggested that the questions be provided to the interviewees prior to the scheduled interview.
- There are no "right" or "wrong" answers. We are asking for your honest opinions so that we can improve the testbed methods and materials.



II. Course of Instruction

1. Has adequate time (or too much time) been allocated for each segment of the course? In answering this question, consider both the trainer course and the student course.

2. Was the number of video segment case studies adequate to teach the 13 basic qualities?

3. Were the written case studies effective in emphasizing teaching points? If yes, was the number of written case studies adequate to teach the 13 basic qualities?

4. Has the course tied crew coordination principles and techniques adequately to the ATMs?

5. How many simulator sessions are required to achieve crew coordination proficiency?

6. What affect, if any, did the pre-training evaluation mission in the simulator have on the classroom instruction part of the course? Should each crew be required to complete a "crew coordination" simulator session prior to the classroom instruction?

7. Would read-ahead packages enhance the flow of the course? If so, what material would you suggest be included?

8. Overall, did the trainer course adequately prepare you to teach the aviator student course?

9. Are there any trainer course segments (for example, MOI, evaluation, scenario familiarization) that should receive more or less emphasis?

III. Scenarios Used During the Evaluation Phase

1. Were the evaluation scenarios of about the correct level of difficulty?

2. Was the scenario reasonably realistic in terms of the types of missions these aviators must execute?

3. Was there enough pre-mission planning time for the crews?

4. Do you have any suggestions for improving the preflight air mission briefing and crew mission briefings?

5. Do you have any suggestions for improving the post-flight crew-level after-action review?

6. Do you have any suggestions for improving the post-flight evaluator debriefing?

7. What general comments did the aircrews make that might help us improve the scenario?

8. Do you have any specific suggestions for improving the scenario and/or the mission objectives?

9. Do you have any specific suggestions for improving the scenario by adding or deleting tasks?

10. Did the scenarios allow adequate demonstration and observation of the 13 basic qualities associated with crew coordination?

11. If the answer to item 10 above is no, what tasks or mission events should be added to permit adequate demonstration and observation of each basic quality?

IV. Evaluator's Workbook

1. How did you utilize the Evaluator's Workbook:

   a. During pre-mission activities?

   b. During the flight?

   c. During post-mission activities?

   d. After the mission was completed (grading and rating)?

2. Regarding the videotapes:

   a. Did you review then evaluate, or did you review and evaluate at the same time?

   b. Did you use the videotapes to review specific areas of the tape where you thought you missed important information?

   c. Did you review the whole tape?

   d. What general comments did the aircrews make as they observed their videotape?

3. What elements of the Evaluator Worksheets were helpful or not helpful, and why?

   a. Segment description?

   b. ATM Task?

   c. ATM Task performance?

   d. Segment overall performance?

e. Aircrew Coordination Basic Qualities?

f. Evaluator's Notes?

4. Were there elements in the Workbook that were confusing? If so, which?

5. Are there some elements in the Workbook that you could do without? If so, which?

6. Are there any additional elements that you would like to add?

7. Do you have any other suggestions for improving the Workbook (be specific)?

V. Aircrew Coordination Basic Qualities

1. Can any of the 13 basic qualities be combined or eliminated?

   a. If two or more qualities are proposed for combining, give specific examples of how they overlap. [Remember: Basic qualities do not have to be completely different from one another.]

   b. If a basic quality is proposed for elimination, give specific reasons why this should not be evaluated as part of crew coordination performance. Also state where this aspect of performance would be evaluated, if not under crew coordination.

2. How were the behavioral rating anchors (text descriptions) useful or not useful to you in achieving reliable and objective ratings of crew performance? Please provide specific examples, if possible.

3. Were some of the behavioral rating anchors more useful than others? If so, which ones were found to be more useful? Which ones were found to be less useful? Please provide specific examples of how you attempted to use the behavioral rating anchors.

4. How were the behavioral evaluation factors (bulletized descriptions) useful or not useful to you in achieving reliable and objective ratings of crew performance? Please provide specific examples, if possible.

5. Were some of the behavioral rating factors more useful than others? If so, which ones were found to be more useful? Which ones were found to be less useful? Please provide specific examples of how you attempted to use the behavioral rating factors.

6. How did you use the evaluation factors? Did you use them to instruct in the classroom or simulator? Crew debriefing?

7. Should we continue to have both the factors and anchors for the evaluation guidance? If we use only one, which one would you choose?

8. Do the audio segments provide adequate opportunity for practicing your application of the rating scales?

   a. Were the 13 basic qualities addressed in an adequate fashion? If not, how could the segments be expanded to address each basic quality?

   b. Would you find *video* tapes to be more useful? If so, what type of vignettes would you recommend be included?

9. Was the 7-point scale a good choice for rating crew coordination basic qualities? Were the descriptors (very poor, poor, marginal, adequate, acceptable, good, very good, superior) for each number helpful? Do you have any suggestions for improvement?

10. Think back to each of the 13 basic qualities. Each has a *behavioral anchor* for numbers 1, 4, and 7.

    a. Were the behavioral anchors helpful?

    b. What are your suggestions for improving them (be as specific as possible so we can incorporate your suggestions)?

11. Think back to each of the 13 basic qualities. Each has *evaluation factors* for numbers 1, 4, and 7.

    a. Were the evaluation factors helpful?

    b. What are your suggestions for improving them (be as specific as possible)?

12. Were you reluctant to give crews ratings below "fully acceptable"? If yes, why?

13. If you had experience using both the behavioral anchors and the evaluation factors, do you think that one or the other methods influenced you to give higher or lower grades? For example, if you used the evaluation factors, do you think that led you to give higher or lower grades than if you had used the behavioral anchors?

14. How often did you refer to the explanations in the behavioral anchors?

15. How often did you refer to the evaluation factors?

16. Did the frequency of referral to the behavioral anchor descriptions change over time (e.g., less referral to the anchor descriptions with experience)?

17. Did the frequency of referral to the evaluation factors change over time (e.g., less referral to the factor descriptions with experience)?

18. Are there any aspects of crew performance not adequately covered in the 13 basic qualities?

    a. If so, would you address these aspects within the context of one of the existing basic qualities? Please be specific.

    b. If so, would you address these aspects as a separate basic quality? Please be specific.

VI. Modified Grade Slips

1. Was the format of the grade slip understandable and easily used? Any specific suggestions for improvement?

2. Did you weight flying skills and aircrew coordination skills differently? Did you give them equal weight?

3. Was the satisfactory plus (S+), satisfactory (S), and satisfactory minus (S-) grading system helpful? Would you like to use S+, S, and S- for APART rides?

4. Would you have liked to use the basic quality notations (1,2, . . .13) for *both* positive and negative crew coordination behaviors? If yes, would using a "+" or "-" sign next to *each* BQ associated with ATM Task performance be a reasonable marking technique, or do you think it would be too complex?

5. When you gave an overall mission grade, what were your criteria?

6. Did you find the Comment Slip useful? If not, do you have any specific suggestions to improve its use?

VII. General Observations

1. What is your overall impression of the adequacy of the *aircrew coordination training* provided? Do you have any recommendations for improvement?

2. What is your overall impression of the adequacy of the *evaluation training* provided? Do you have any recommendations for improvement?

3. What is your overall impression of the conduct of the aircrew coordination evaluations? Do you have any recommendations for improvement?

4. If this training package is fielded Army-wide, should there be a system to track testbed participants in longitudinal studies of the Army's crew coordination program?

5. What effect has participation in this project had on you personally?

6. Do you have any questions or concerns that you would like to ask or convey to the crew coordination staff?

Appendix E-2

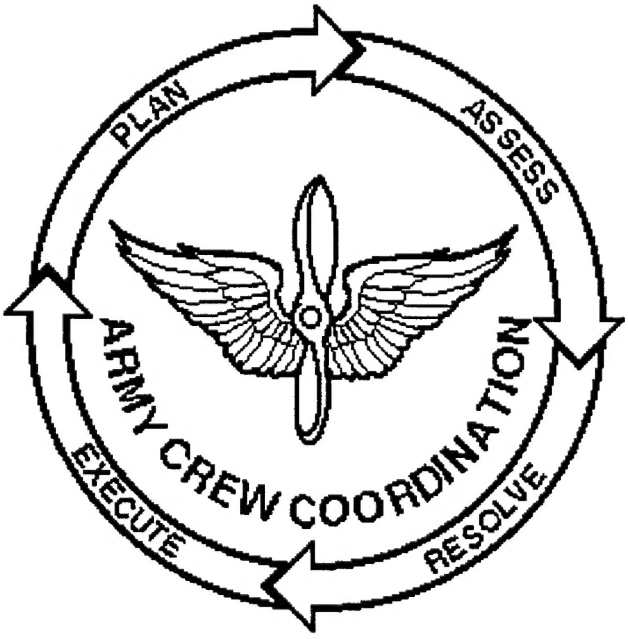
Aircrew Coordination Training Validation Testbed
Crewmember Exit Interview

I. Introduction

This form is to be used as general guidance in structuring the debrief for the crewmember participants in the aircrew coordination validation testbed, August 1992. Questions are basically conversation starters and are not meant to limit free discussion; follow where the comments may lead and develop points as necessary. The debriefing forum will involve small group interviews according to the published schedule.

Important

- Participants must bring the Aircrew Coordination Student Course Outline and Reference Book (Volume 2) to the debriefing.
- It is suggested that the questions be provided to the interviewees prior to the scheduled interview.
- There are no "right" or "wrong" answers. We are asking for your honest opinions so that we can improve the testbed methods and materials.



II. Course Administration

1. Was the classroom appropriately arranged for the number of students present?

2. Was the number of students in the class about the right size for this training?

3. Did the videotaping of the classroom instruction detract from or enhance the classroom environment? If so, how?

4. Was the instructional staff properly prepared to conduct the course? If not prepared, what deficiencies did you note?

5. Were the facilities adequate during the simulator phase of training? If not, what was unsatisfactory?

6. What changes do you recommend to improve the administration of future courses?

III. Course Structure

1. Was the course well organized in terms of subject flow:

   a. overview?

   b. history?

   c. structure of the course?

   d. crew coordination model?

   e. crew coordination elements?

   f. basic qualities?

   g. crew coordination objectives?

   h. definition, discussion, effectiveness factors, and examples of basic qualities?

   i. phase review?

   j. hands-on simulator application?

2. Were the subjects presented applicable to your job as an Army aviator?

3. Were the subjects well developed so that you are confident that you understand the material?

4. Was the interrelationship between crew coordination elements in the ATM Tasks, the basic qualities, and the crew coordination objectives clearly established?

5. Were the basic qualities well defined and explained?

6. Were the effectiveness factors clearly linked to the basic qualities?

7. Were the crew coordination objectives well demonstrated in terms of case studies?

8. Were the crew coordination objectives well demonstrated in terms of video segments?

9. Was there about the right mix of video and written case studies to help you understand the basic qualities and crew coordination objectives?

10. Was the Student Handout satisfactory?

    a. Did it assist you in following the instructor's presentation?

    b. Was there sufficient white space for taking notes?

    c. Should any other items be added?

11. Did you read any of the articles in the Reference Book? If yes, which ones and were they informative?

12. Was the mission planning and rehearsal practical exercise helpful? How could it be improved?

13. Was the communications practical exercise helpful? How could it be improved?

14. Did you complete the Hazardous Thought Pattern exercise? If not, do you plan to do so? If you did, was it helpful?

15. Did you complete the Stress Management exercise? If not, do you plan to do so? If you did, was it helpful?

16. Was the course the right length to teach crew coordination? If not, what adjustments are necessary?

IV. Flight Simulator (hands on)

1. Was the purpose of the simulator phase explained?

2. Was the hands-on phase necessary to effectively teach crew coordination principles?

3. Was the "crawl-walk-run" approach to the training and evaluation rides effective? More rides needed? Adequate number of rides? Too many rides?

4. Did you have enough time during the hands-on periods; that is, pre-mission planning and rehearsal, mission execution, and after-action review?

5. You participated in four simulator rides during the testbed. What did you think about these rides in terms of whether they reflect the types of missions you fly? In terms of the level of difficulty?

6. Do you feel that the use of the videotape of your crew's simulator flight during the instructor debriefing was a good training technique? Why?

V. General Observations

1. What is your overall impression of the adequacy of the aircrew coordination training provided? Do you have any recommendations for improvement?

2. What is your overall impression of the conduct of the aircrew coordination evaluations? Do you have any recommendations for improvement?

3. Do you personally feel that you are now better prepared to perform as an Army aviation crewmember? Why?

4. Would you recommend that this course be attended by every Army aviator? Why?

5. If this training package is fielded Army-wide, should there be a system to track testbed participants in longitudinal studies of the Army's crew coordination program?

6. What effect has participation in this project had on you personally?

7. Do you have and questions or concerns that you would like to ask or convey to the crew coordination project staff?